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Courtesy Lieutenant Colonel Ernst Otto, German Army

THE AUTHOR OF THE ARTICLE "THE BATTLE AT BLANC MONT"

As battalion commander, in front of his dugout in the rifle pits, near Sommepy. The picture shows plainly the chalk rock which gave Blanc Mont its name.

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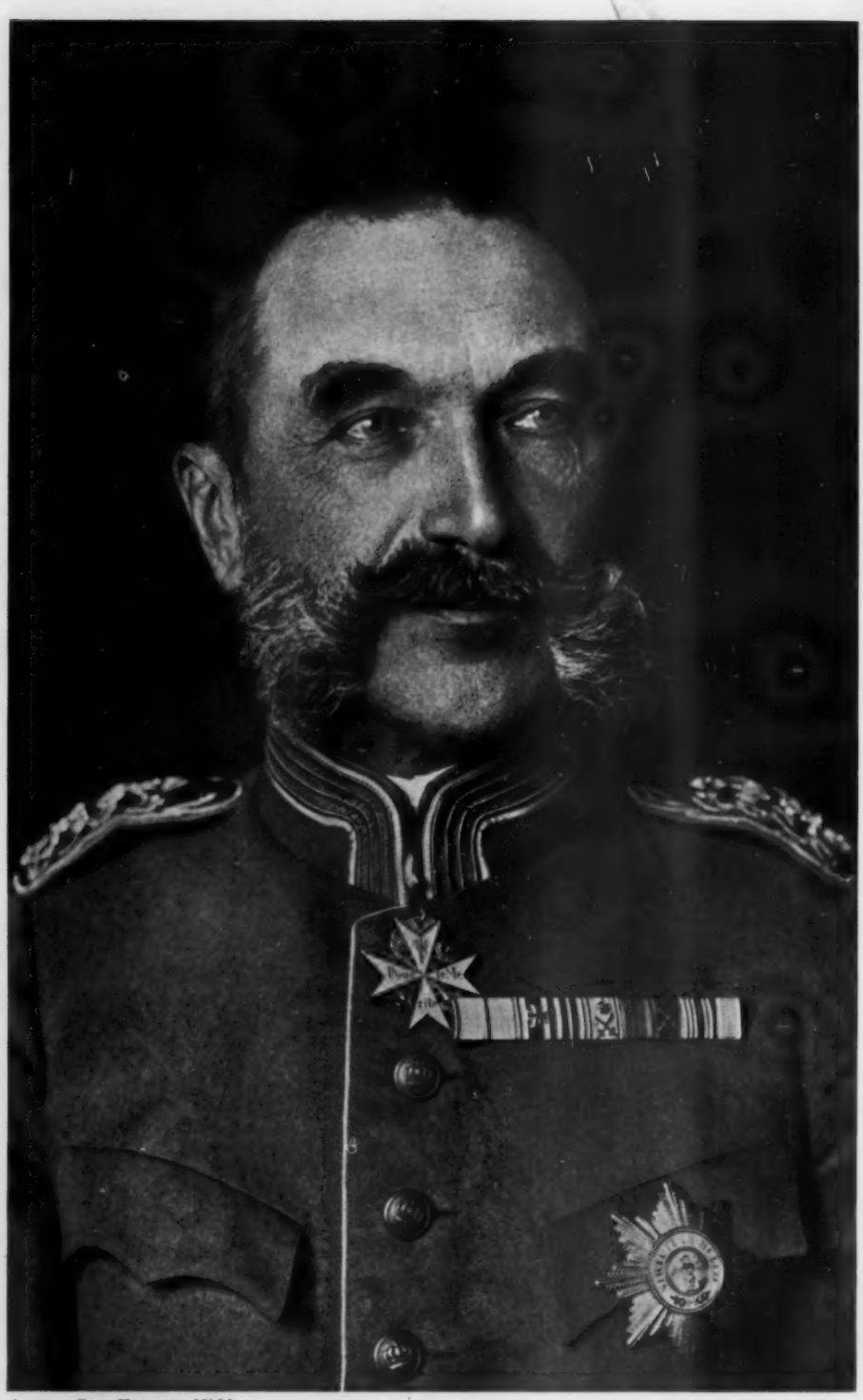

Courtesy Frau Krug von Nidda

GENERAL OF CAVALRY KRUG VON NIDDA

Commanding general of the 12th Saxon Army Corps, who at the time of the Battle at Blanc Mont conducted the struggle for the German defense of the Py sector.

MAJOR GENERAL JOHN A. LEJEUNE, U. S. MARINE CORPS

Who commanded the American 2nd Division during the operations which resulted in the capture of Blanc Mont.

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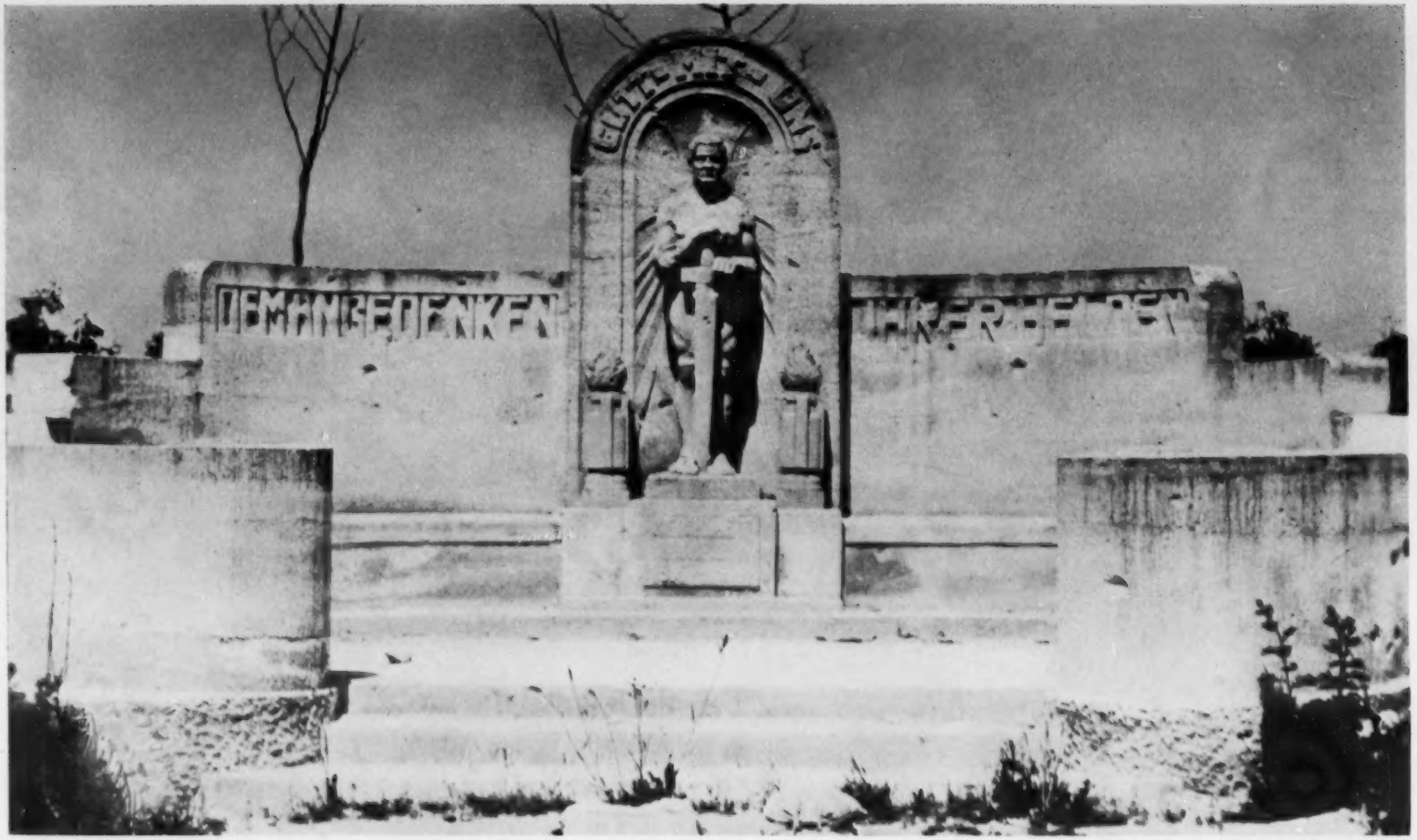

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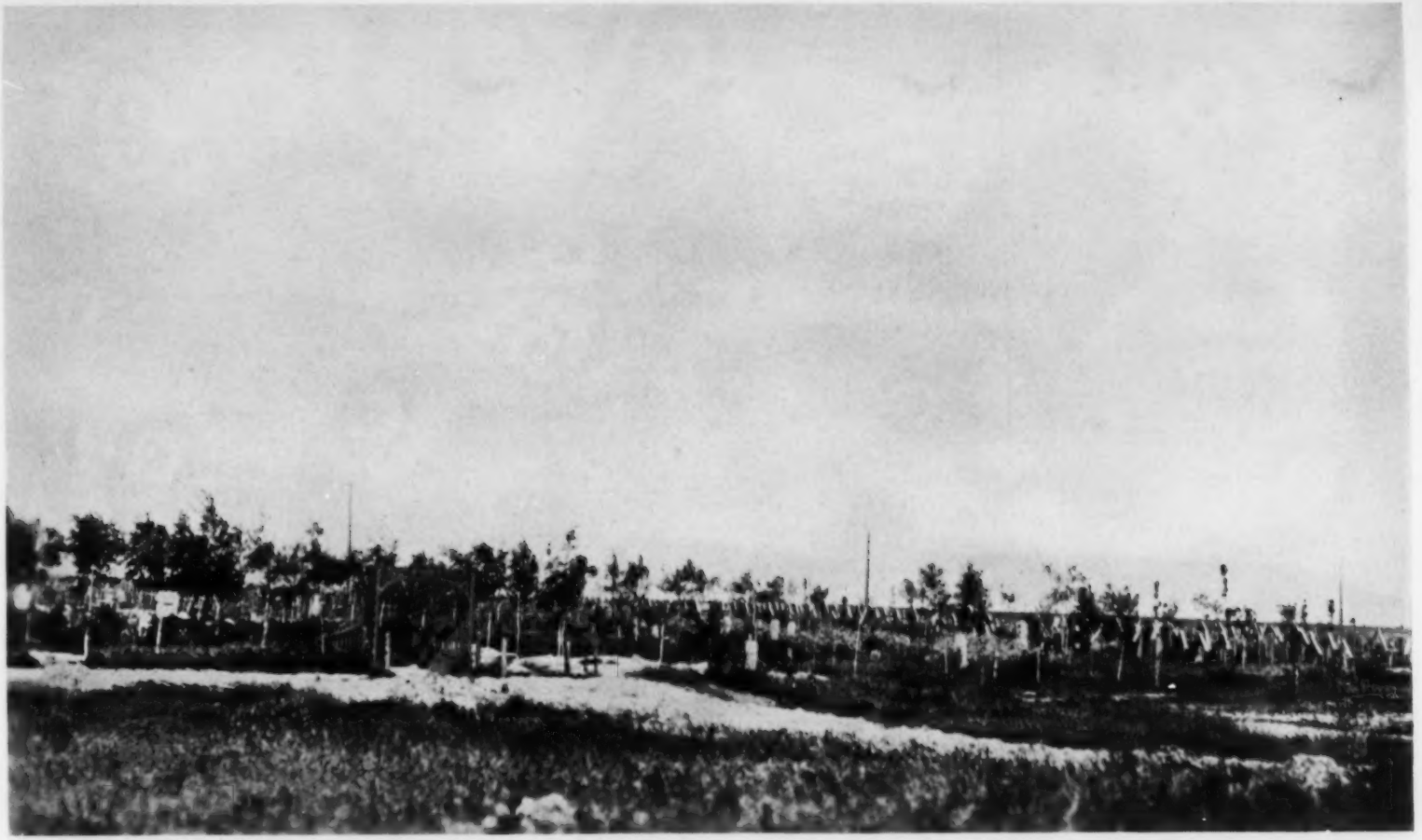
GERMAN MONUMENT IN CEMETERY AT ST. ETIENNE A ARNES
Machine-gun pit in foreground.



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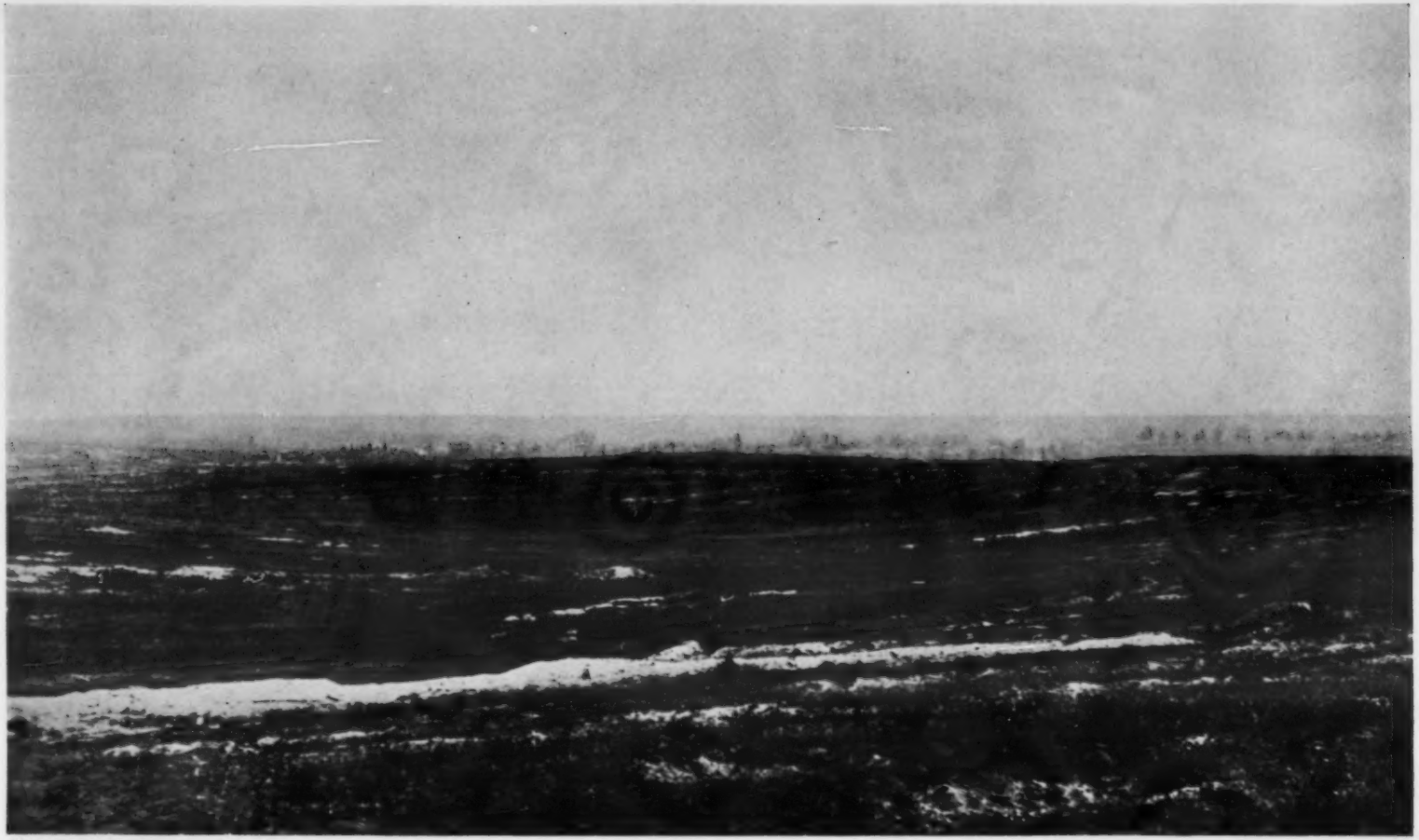
VIEW OF CEMETERY AT ST. ETIENNE A. ARNES
As seen by the 1st Battalion, 6th Marines, in its attack.



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VIEW EAST FROM ESSEN HOOK, OVER WHICH THE MARINES ADVANCED

Essen Hook (American designation of Helenen Hill) was still held by the Germans and this view shows the fire from the left rear and flank to which the marines were subjected until the Hook was captured.

marines were subjected until the Hook was captured.

Courtesy Lieutenant Colonel Ernst Otto, German Army

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SOMMEPY

Ruins of the destroyed church.

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Courtesy Lieutenant Colonel Ernst Otto, German Army

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ADVANCE OF A GERMAN INFANTRY ESCORT BATTERY

In a counterattack.

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The conqueror of one pole attempts the other.
Commander Byrd, the Antarctic, 1929

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The Battle *at* Blanc Mont

(*October 2 to October 10, 1918*)

By LIEUTENANT COLONEL ERNST OTTO, *German Army (Retired)*

Translated from the German by MARTIN LICHTENBERG, *U. S. Marine Corps*
Army War College

I SIT here at my desk, bent upon giving an impartial account of how the German positions at Sommepy were captured by the French after tenacious encounters, were then occupied by the American 2d Division, and how subsequently the combats around the Blanc Mont developed. As if by magic, my glance is drawn to a white-framed picture on the desk. To my mind returns a vision of the days when we were constructing dugouts in the Sommepy sector. Frequently chips were broken loose from the chalk-limestone which formed the lower stratum. Out of this stone, easily carved with a pocket knife, our men during off-hours cut small souvenirs, such as frames, ink blotters, ash trays, etc., for the people at home. When, back in 1916, I was in lines with my battalion—the 1st Battalion, 184th Infantry Regiment—at Sommepy, my servant carved this frame which I now behold out of the same limestone that, incidentally, gave Blanc Mont, or the White Mountain, its name. Presumably, American soldiers in October of 1918 likewise during lulls in the fighting carved similar souvenirs for their loved ones from the limestone of Sommepy, and also, astonishment in their eyes, inspected the many casemate-like, bomb-proof dugouts with their numerous exits and subterranean passages, designed to shelter entire companies, which were hewn into the limestone of the hills south of Py brook.

From the German point of view, the battle at the Blanc Mont represents a portion of the defensive battle in the Champagne and Meuse sectors between September 26 and November 11, 1918. For the Americans, this battle was a part of the Meuse-Argonne offensive which was in turn one of the important steps in the tremendous general attack of the Allies beginning on September 26, 1918, along our entire front, from the Swiss border to the North Sea.

One must know, in order to understand these combats clearly, what had been the aims of the German Higher Command hitherto, and what decisions it had reached at this time.

About the close of 1917, the German Higher Command had decided to bring the warfare in the west to a climax during the coming spring, in other words, *before the entrance of the United States might be felt on the Western Front.* With its sweeping offensives, the "Great Battle in France" (March 21 to April 6, 1918), the "Battles at Armentières and around Kemmel Hill" (April 9 to April 29, 1918), as well as the

Chemin des Dames Offensive, the "Battle at Soissons and Rheims" (May 27 to June 13, 1918),[1] Germany had indeed attained tremendous successes, but had not yet struck a decisive blow. For the future, the Higher Command still held fast to its policy of controlling the enemy's decisions by a continued German offensive. It desired, before substantial forces of the American Army became engaged, to launch a mighty blow in Flanders in the direction of Poperinghe-Cassel, starting from the Ypres–Vieux Berquin line, in order to penetrate the north flank of the British troops, push these and the Belgians against the North Sea coast, and thus force them to enter peace negotiations. Before launching this project, however, it was the belief that still another feint attack was needed, to draw the French reserves from behind the British front. This operation was what is known as the "Offensive at the Marne and in the Champagne," July 15 to 17, 1918.

This offensive was a failure. In an endeavor to ward off the attack following immediately in the woods of Villers-Cotterets by the French General Mangin (July 18, 1918), the Higher Command had to employ part of the reserves it had held ready for the great Flanders offensive. Following upon the fact that during the fighting at Soissons and Rheims, the Allies' casualty list had exceeded the Germans' by 47,192 killed, wounded, and missing, our Higher Command received information that during the second battle at the Marne the losses of the Allies were again greater by 42,065. This total excess of 89,257 killed, wounded, and missing in itself would have represented a giant victory over the allied French and British, had their losses not been compensated by the appearance at the front of fresh American divisions. Germany, on the other hand, was in no way able to replace the casualties her own divisions had suffered. Now, on July 20, 1918, the Higher Command was obliged to abandon its plan of an offensive in Flanders, and turn completely to the defensive.

In the German Army, the World War had brought common acceptance of the principle that, during defensive operations, it was generally less important to hold any piece of terrain than to inflict heavy losses on the enemy for its possession. At any rate, in the situation then existing the possession of any particular line no longer played a very important rôle. But it was essential that by every possible means the defensive should be so conducted as to inflict ever increasing losses on the enemy, so that, to avoid further bloodshed, they might offer Germany an acceptable peace. Hence the German Army, from July 20, 1918, no longer fought for final victory, but simply to secure for the Fatherland an endurable peace.

Not a thing was left undone by the German Higher Command to prevent a catastrophe and to spare its heroic troops, always willing to sacrifice their lives, an ignominious defeat such as we ourselves had forced upon the French in 1870 at Sedan, and upon the Russians in 1914 at Tannenburg. Even if not everything could be attained in the political field, it was essential that our troops should be able to march back into the Fatherland with their heads proudly held high, conscious that they had remained undefeated in the field.

With these conditions in mind, the Higher Command on September 6, 1918, ordered the Hunding-Brunhild-Argonne position to be fully completed for occupation by the Group of Armies of the German Crown Prince.

For a strategic retreat between the Oise and Argonne, a plan, the so-called "Gudrun Operation," had since 1917 been worked out in all details. It was essential, for further continuation of warfare, that the Higher Command be assured of the possibility of carrying out this scheduled plan.

Since the offensives of the year 1918 had somewhat changed the general aspect of the situation, it developed that the Gudrun Operation had to be worked over accordingly. Fortunately then, it was not too late when, on September 23, 1918, the Group of Armies of the German Crown Prince was able to issue orders for a revised Gudrun Operation which regulated a systematic retreat before an overwhelming attack, such as we were, on September 26, to be subjected to. The details and instructions, insofar as they are of any interest to us, are shown on Map A.

Provisions were made to enable the 7th, 1st, and 3d Armies, provided the strategic situation should demand such action, to retreat within three marching days into the Hunding-Brunhild-Argonne position. This sector extended along the line Grécy sur

[1] TRANSLATOR'S NOTE: The author here refers to books published under these titles.

Serre-Vesles-Sissonne-St. Quentin-Rethel-Amagne–Alland Huy–Mouron–Autry–Condé–Very, utilizing, in its most important portion, the Aisne sector.

These orders presented a definite scheme for a large-scale "withdrawal from contact with the enemy"; at the same time, the Crown Prince's Armies most emphatically retained the power of decision as to the length of time allotted for the defense of the separate sectors. The instructions, issued on September 30, 1918, from the Group of Armies of the German Crown Prince were as follows:

(1) Forward of the Hunding-Brunhild position as far as Mouron, troops on fronts where heavier enemy attacks may be expected will in general, retreat. The retreat requires previous authorization by the High Command. Any officer who, upon his own responsibility, retreats with his troops in combat without previous permission by higher authorities, will be required to account for his actions.

(2) In preparation and execution, each separate retreat will be considered a special problem as part of the Gudrun Operation. All practical and theoretical Gudrun preparatory details will be evaluated. Taken together, all the retreat operations will gradually lead to the Hunding-Brunhild position. There will be contact at points east of Mouron with the forward positions of the 3d and 5th Armies. Utilizing all available means, these positions will be maintained and fortified as so-called permanent positions.

(3) *On fronts where at present the troops are engaged in major combat,* the battle for the possession of the foremost combat zone will be continued. As soon as a pause occurs, provided the sector heretofore the subject of combat offers no prospect for future profitable defense, a recommendation will be submitted regarding contemplated future operations. In all cases it must be considered whether or not a too early withdrawal of the front lines will not suggest to the enemy an opportune moment for resuming his attacks on a still larger scale.

(4) Each retreat movement will be utilized to inflict heavy enemy losses wherever possible, even by counterattacks of the most unimportant nature. Only by following this method will it be possible to guard the troops against the moral dangers of retreat and hold them firmly in hand.

(5) The retreat movements for withdrawals from sector to sector will be prepared in such a manner as to allow their execution within *one night* provided orders pertaining thereto are issued by 9:00 A.M. prior to the night on which the retreat is to take place.

These instructions are directly responsible for the characteristic aspect of the defensive combats between October 2 and October 11, 1918, which we here review.

At 11:00 P.M., September 25, 1918, the enemy launched a severe surprise fire of all calibers on the entire front of Group Py (Corps Headquarters, 12th Army Corps); at dawn, the hostile infantry, under the protection offered by a destruction fire of tremendous volume, aided by fog, entered the outpost area. This was the attack made by the French 11th and 21st Corps. After vicious encounters that lasted until September 30, 1918, they succeeded in forcing the German divisions from the hills south of the Py brook to the hills to the north of the valley. However, our right flank, located in the vicinity of Marie-à-Py, was able to hold its own.

THE FIRST DAY OF OCTOBER
(See Map B)

An attack against the western portions of the position, which was launched on October 1, was repulsed. While he failed here, the enemy, in an attack made during the afternoon with utmost energy, and with the assistance of armored cars, succeeded in capturing Py Hill northeast of Sommepy. This situation is clearly shown on Map B of 9:00 P.M., October 1.

In estimating the situation of September 29, the Higher Command made the following statement:

On September 27, American and French troops launched a major attack on a broad front between Verdun and Rheims. Continuation of the attack is to be expected. Numerous French and American reserves have been moved behind the front for this purpose. Among the American reserves here we find that there are as yet only four divisions all of which have previously been on the front. However experience proves that even new American divisions are being inserted in the lines to participate in major attacks alongside more experienced and trained troops. Consequently, the advent at the front of the ten additional American divisions, already suspected of being in France, but not yet in appearance, must be reckoned with.

It would be proper to mention here that, after Bulgaria had on September 28 entered into armistice negotiations with the Entente, the German Higher Command on September 29 also demanded of its government an offer for armistice and peace negotiations.

The commanding general of the 12th Army Corps, General of Cavalry Krug von Nidda, on October 1, 1918, gave the following estimate of the situation:

The main stress of the hostile offensive is clearly recognizable as lying between the Sommepy and St. Etienne road and Aure-Semide and will continue to be exerted on that point. The numerous reserves which have crossed the eastern basin of the Py brook in a northerly direction in an uninterrupted flow throughout the day as well as the great number of tanks hitherto unemployed in the line which have disappeared from support positions, leave no doubt that, on October 2, a hostile attack is to be expected in the same combat zone and that it will be at least as severe as yesterday's attack. It can only be warded off if the long and unfavorably located front line is reënforced by fresh forces which could be placed in support in the line that extends from the south

slope of Schlesier Hill to the northwest edge of Rheinischer Grund at the boundary line between the sectors of the 7th and 15th Bavarian Infantry Divisions. The forces of the Group are at present insufficient to properly accomplish this operation, despite the switch position that has been thrown up between Helenen Hill and the southern corner of the Third Main Line of Resistance, the establishment of which was forced upon the command after the combat strength of the 51st Reserve and the Bavarian Infantry Divisions had melted to almost negligible qualities.

There was no attack launched against the sector of Group Langer on October 1, but at about 10:00 A.M., the 42d Infantry Division of Group Perthes repulsed an attack.

At 8:40 P.M. Group Py ordered the following for October 2:

The 200th Infantry Division, 15th Bavarian Division, and 3d Guard Infantry Division will maintain their positions; the 7th Infantry Division will withdraw its lines as far as the line of Tor Hill—along the main line of resistance as far as Altona—Mulde—Stallmulde—the

strong point at the east slope of the Helenen Hill. The outpost area will extend as far as the Second Main Line of Resistance.

During the night, all units of the 199th and 203d Infantry Divisions will withdraw from the lines. Those of the 199th Infantry Division will concentrate in compliance with orders of the division; those of the 203d Infantry Division will occupy a support position in the following order: the 406th Infantry Regiment at Orfeuil, the 409th Infantry Regiment at Médéah Hill, the 410th Infantry Regiment at Bémont Ferme.

The relief of the 7th Infantry Division by the 51st Ersatz Division, and the Guard Fusilier Regiment of the 3d Guard Infantry Division by one regiment of the 199th Infantry Division, will be carried out during the night.

The boundary between the 7th Infantry and 15th Bavarian Infantry Divisions is traced as follows: Fuchsgrund—Torholz—Steinberg—Bémont Ferme road.

Support troops: Guard Fusilier Regiment behind the right flank of the 3d Guard Infantry Division.

The boundary between above division and the 15th Bavarian Infantry Division is as follows: west slope of Schanze—center of Berliner Hill —*d* of the word "Sperlingsgrund-Damm" on Schneisen ridge.

During the night of October 1 to 2, a severe heavy-caliber harassing fire was laid on the roads and villages and camps in the rear. The German artillery replied energetically with harassing fire on hostile troop concentrations and support areas.

At 2:30 A.M. Corps Headquarters ordered the following:

The 7th Infantry Division will be transported to the sector of Group Langer as soon as possible, and will be billeted there. This division will place an assault group in support at the Blanc Mont. This order will be executed by 5:00 A.M., October 2.

Early in the morning the relief of the 7th Infantry Division was completed, the 51st Reserve Division taking over the former's sector.

THE SECOND DAY OF OCTOBER

(See Map C)

This was the situation on the German front when, at 9:00 A.M., October 2, the American 2d Division took over the sector in which it had relieved the French 61st Division during the preceding night. The 2d Division was under the command of the French 21st Corps, which in turn was a part of the French 4th Army. In the front lines the 4th Brigade was employed in the following order: 5th Marine Regiment at the right, 6th Marine Regiment at the left. The 3d Brigade (consisting of the 9th and 23d Infantry Regiments), remained in reserve south of Navarin Ferme. The artillery of the French 61st Infantry Division remained in lines. It had been reënforced by the artillery of the 2d Division and placed under the latter's command.

The American 2d Division formed the left flank of the French 21st Army Corps. It was framed in on its left by the French 21st Infantry Division of the French 11th Corps, on its right by the French 170th Infantry Division of the 21st Corps. However, during the night of October 2 to 3, this latter division was relieved by the 67th Infantry Division.

In reviewing these daily battles, I will consider the events on the American side according to the sources available to me. They are "Monograph 9: 'Blanc Mont'," obtained from the Historical Branch, War Plans Division, General Staff, of June, 1921, and "Summary of Operations, 2d Division" (plus 71st Brigade, 36th Infantry Division, Meuse-Argonne Operation, October 2 to 9, 1918), published by the American Battle Monuments Commission. This will be followed by a characterization of the German side built up with the aid of war diaries, combat reports, orders, messages, etc. This latter source material is substantially more copious as is shown by the following brigade order of the commander of the 102d Reserve Infantry Brigade, which participated in the combats, issued on October 8:

The high importance of future war-historical records makes it the duty of all officers, immediately after the termination of combat activities, to work up the war diaries so diligently that the graphic descriptions, the inspection and perusal of material upon which final compilations are based, and the establishment of lists, shall be completed before new troops are employed in the sectors in question. The fresher the impression, the better and more dependable will be the presentation.

In further instructions he adds this:

Save everything. Save every scrap of paper that is seemingly unimportant, every notice, every word, even the most insignificant-looking piece of paper as long as it has even a remote bearing upon the phases of combat. During combat activities the staffs will at all times,

MAP "C"
14. I.D.
4th MAIN LINE OF RESISTANCE
200. I.D.
51st Res. I.D.
203. I.D.
42nd I.D.
3rd Guard I.D.
Schnellsen R&C-Ken
St. Eliseu
Bleinitz Hill
Ludwigs-Wacken
Peters Berg
Grenadier Hill
MEDEAH FARM
Pioneers Berlin Hill
Steinberg
Sachsen Knoll
Liry
3rd MAIN LINE OF RESISTANCE
Hansen Wacken
BLANC MONT
Schlesier Hill
Schanze
FRENCH TROOPS
Tan Hill
DRESDEN HILL
LEIPZIGER HILL
2nd MAIN LINE OF RESISTANCE
Helenah
St. Souplet
Sommery
Combat Zone Of 2nd American Division
Approximate Trace of the Front Line
Bavern Hill
Navarina Farm
LEGEND:-
: This area was not involved in the American Attack
: Boundary lines of American Attack
Situation On Oct. 2nd 1918,
Showing the American attack of Oct 3rd 1918.
MAP SCALE 1:25000

whenever a favorable opportunity offers itself, send all reports, orders, sketches, etc., to the rear when they are no longer needed at the front. Otherwise, much valuable material will be lost; moreover, they are an unnecessary burden.

In this account I will use Central European time. The Americans used Western European Standard time. The difference is exactly one hour: 9:00 A.M., as stated here, is 8:00 A.M. according to the American original reports.

The combined American-French attack was scheduled to be launched as early as October 2, 1918, but had been postponed to the following day. The American 2d Division on this day was confronted only with the problem of forcing the Germans out of their outpost positions, which extended north of Sommepy as far as the same trench which further to the eastward was held by the Americans. As we have already seen, the 7th Infantry Division had received orders to withdraw its lines as far as Tor Hill–Third Main Line of Resistance–Helenen Hill during the same night, so that the Americans were consequently able to occupy the former German outpost position without encountering resistance. Its left neighbor, the French 21st Infantry Division, was still considerably to the rear of the Americans. The right neighbor of the 2d Division, the French 170th Infantry Division, however, had had a series of important battles. We must review them because they are of substantial importance in giving a clear picture of the situation that prevailed on October 3.

At 10:45 A.M. Group Py issued the following order to the 203d Infantry division:

The following regiments will be shifted: The 409th Infantry Regiment will be moved into the area between Schlesier Hill and Médéah Hill; the 410th Infantry Regiment will be moved into the area between Médéah Hill and Steinberg. The elements of the 406th Infantry Regiment still located at the Schanze will be withdrawn and placed in the strips of woods north of Jüterbog depression; the last battalion of this regiment with its accompanying battery will remain at Orfeuil.

Thereafter, the group ordered that the 203d Infantry Division relieve the 15th Bavarian Infantry Division and the left flank of the 51st Reserve Division (as far as the highway), during the night of October 2 to 3. This relief was to be carried out while an attack, designed to recapture the positions between Tor Hill and Schanze, lost the day before, *was still under way*. The attack was scheduled to be launched at 5:00 P.M. The elements of the 15th Bavarian and 51st Reserve Divisions then still in lines were not to participate.

However, shortly after 11:00 A.M. the enemy, which, of course, was the French 170th Infantry Division, attacked the front from the Rheinischer Grund as far as Breiter Rücken (broad ridge) which was held by the 15th Bavarian and 3d Guard Infantry Divisions, launching at the same time a bombardment of drum-fire proportions. Employing strong forces, the enemy succeeded in entering our lines and forcing our troops back on Steinberg-Orfeuil and even beyond the long depression. Strong hostile bombing squadrons participated in the action.

It was now evident that it had become impractical to withdraw the 406th Infantry Regiment from the weakly occupied Schanze. Acting upon the report that the enemy had entered our lines at the Schanze and points west thereof, and was in the act of approaching Orfeuil, Group Py at 1:20 P.M. ordered the 203d Infantry Division to form for and immediately launch the attack that had been scheduled for 5:00 P.M.

During this attack the 409th Infantry Regiment, advancing from a line of departure on Steinberg, succeeded in recapturing the northern trench of the Bémont switch under a severe enemy artillery bombardment. The French could not be dislodged from the southern trench. The 410th Infantry Regiment was checked in its advance in the woods south of the Médéah Ferme, and was unable to advance properly; it had been ordered to recapture Tor Hill. From 2:10 P.M. on, the 406th Infantry Regiment fought at Orfeuil, the hostile infantry offering very little resistance. However, the casualties it had suffered during the advance through the hostile artillery barrage had been so heavy that this regiment, too, was unable to make any headway. Renewing its attacks, the 410th Infantry Regiment succeeded at 9:00 P.M. in capturing and maintaining Tor Hill.

This attack of the 203d Infantry Division coincided with a new French attack which, with the assistance of tanks, had been launched at 5:14 P.M. against the entire front

of the 200th Infantry Division but which had been completely repulsed.

On this same day, October 2, furious attacks were launched around Liry Hill in the sector of Group Py which had been temporarily lost but which was then recaptured during a counterattack. Troops at the Liry Hill, Wittelsbacher Hill, and Flieger Hill warded off three serious hostile thrusts, and another final attack against Liry Hill was defeated after a desperate hand-grenade battle. As compared to these activities, things were almost completely quiet in the sector of Group Langer.

What was the combat value of the German troops at this time? In the evening of October 2, 1918, the 3d Guard Infantry Division reported the following:

> The heavy losses, the superhuman demands placed on the physical capacities of the men during the past few days, have reduced the combat value of the division, not entirely satisfactory even before employment in lines, to a most dangerous degree. Physically and morally, the troops have now arrived at the extreme limit of their endurance. At the present time the trench strength of the division has shrunk to 350 men, who are holding a line two kilometers long. The division requests to be relieved.

The 200th Infantry Division submitted the following report of a battalion commander then in front lines:

> I consider it my duty to call attention to the present condition of the troops. As a result of physical and mental exertions, the troops have grown apathetic and indifferent to such an alarming extent that I can no longer guarantee that, during a surprise attack, they will continue to hold the positions.

Regiments and brigades joined in this opinion. The commanding general, Krug von Nidda, reported to Headquarters, 3d Army:

> This excellent division which, for the past ten days, has been uninterruptedly engaged in major combat and has so valiantly distinguished itself, has now reached the limit of its endurance and is urgently in need of relief.

With the 15th Bavarian and the 51st Reserve Divisions, things were still worse. More favorable was the verdict regarding the 213th Infantry Division:

> Since the beginning of February this division has had no rest; the necessary training is consequently lacking. Nevertheless, the morale of the men of the regiments, consisting of Lower Saxonians and Pomeranians, is little short of excellent, their health condition satisfactory. There is no doubt but that the energy and strength of the troops have been severely taxed as a result of the continuous helter-skelter movements but at the same time the rifle strength of the separate battalions, even considering the casualties of the past few days, averages about 650 men of whom, however, a considerable portion are not fully trained.

The divisional commander bemoans the fact that his division has always been split up along the front:

> If a division is employed in lines uniformly, under its own trusted leaders, and not at numerous points of the front at one time, its men will give their utmost and obey orders in spite of inadequate training. But its combat value may be substantially deteriorated if the practice of scattering organizations under strange leadership is continued and if the troops are thrown into combat only after constant movements have prematurely exhausted them.

That in the evening of October 1 men of the baggage trains had to be employed in lines, and that, at Blanc Mont, a Landsturm battalion consisting of old, poorly trained men who had hardly ever handled a gun, was also thrown into the breach, is shown on the map.

The Third Day of October

*(See Maps D, E, F, and G, and Appendix I.)**

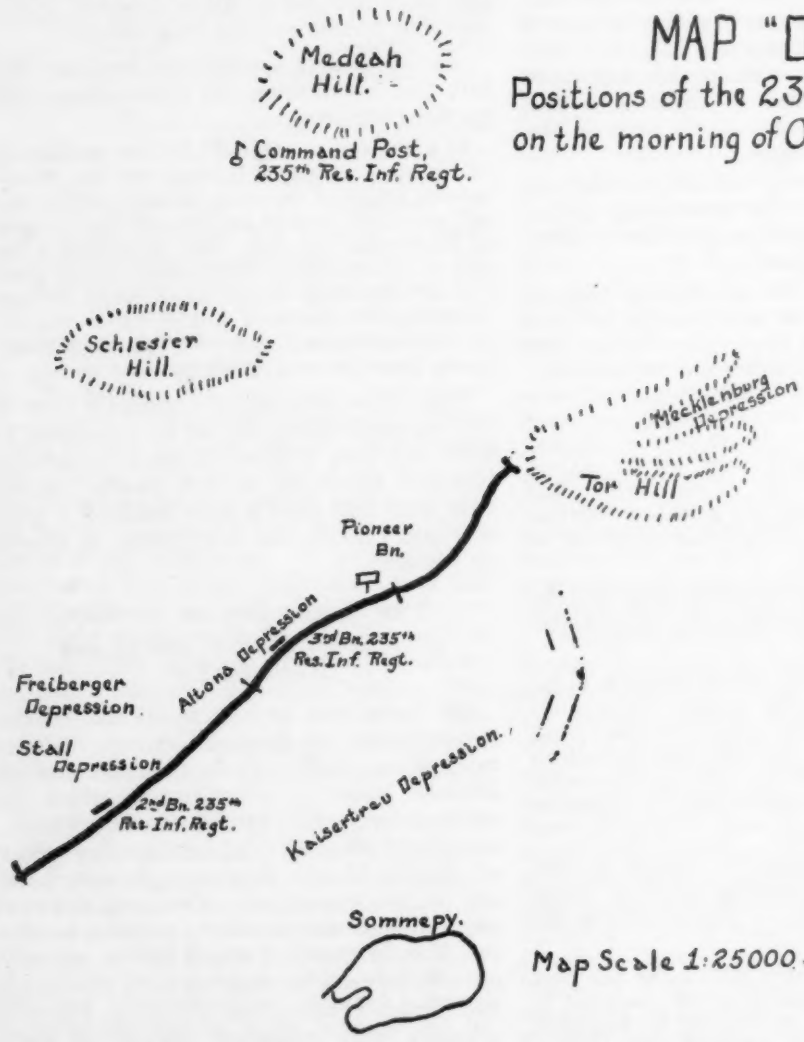
We have now arrived at the day of the major combat, the third of October. On October 2, at 12:00 o'clock midnight, the 2d Division issued its attack orders, which the commander of the 4th Marine Brigade received at 5:40 A.M. The commanding officer of the 6th Marine Regiment, however, did not receive this attack order until the moment when it was necessary to form for the attack, as a result of which he was actually not able to read its contents until his troops had already reached their objective. The two brigades were employed abreast of each other, in the following order: the 3d Brigade at the right with the French 3d Tank Battalion, the 4th Brigade at the left, reënforced by the French 2d Tank Battalion. In each of the two brigades, one regiment advanced in the front lines, the other regi-

* All appendices to this article will be printed with the last installment, April, 1930. Appendix I shows the order of battle of the French Group of Armies Maistre.

ment followed in its wake as a reserve. The foremost regiment advanced in three attack waves, each wave consisting of one battalion.

The attack objective was the road leading from Médéah Hill to Blanc Mont.

The attack was assisted by the fire of the Field Artillery Brigade of the 2d Division,



MAP "D"
Positions of the 235th Res. Inf. Regt. on the morning of October 2, 1918.

Map Scale 1:25000.

and the artillery of the French 61st Infantry Division as well as the French 252d Aviation Squadron.

It had been decided previously that the infantry was to launch its attack at 7:30 A.M. This hour, however, was advanced so that the attack actually got under way at 6:50 A.M. The artillery preparation had begun at 6:30 A.M.

On the line of departure it so happened that the 5th Marine Regiment was at the right and the 6th Marine Regiment, both of the 4th Marine Brigade, at the left. The latter was now ordered to attack first while the other regiment had to await its turn and then fell in behind the 6th Marine Regiment, whereby it shifted its direction of advance somewhat to the left. More difficulties were encountered by the 3d Brigade. From its position near Navarin Ferme, it had been ordered to reach its line of departure during the night. This, however, as no one knew, was still occupied by the Germans. The guides promised by the French 170th Infantry Division did not show up and conse-

quently the brigade wandered about during the night until at about 4:00 A.M. it occupied a position that lay five hundred meters farther southeast of the Sommepy-Médéah Ferme road; indeed the 23d Infantry Regiment arrived at this point only just before the launching of the assault. When forming for the attack, a gap developed between the sectors of the two brigades of more than one kilometer's width—according to the map it is even two kilometers wide, which, however, was closed up as the two brigades advanced and later captured the remaining German outposts between the two lines.

In the sector of the 3d Brigade we find the 9th Infantry Regiment in lines, with the 23d Infantry Regiment in reserve. At the right, the assault was accompanied by the French 67th Infantry Division. The front-line regiment of the 3d Brigade and the 9th Infantry had in its first line the 1st Battalion, in the second line the 2d Battalion (support) and in the third the 3d Battalion (reserves). When, while forming for the attack, the 1st Battalion, 9th Infantry, was subjected to artillery fire, it withdrew into the depressions to the left. The 2d Battalion, 9th Infantry, continued the attack in a straight line. The 1st Battalion, 9th Infantry, again approached the fighting line after progressing through the depression and thereupon both battalions, the 1st at the right and the 2d at the left, continued forward as front-line units. When, at 9:30 A.M., the first attack objective had been reached, the 1st Battalion, 9th Infantry, took over the entire sub-sector of the brigade, and the 2d Battalion, 9th Infantry, was placed immediately behind as a support. At the left, contact was established with the 6th Marine Regiment; at the right with the French 167th Infantry Regiment.

As the 4th Brigade formed for the attack, we find that its right flank was located at the road crossing one kilometer northwest of Sommepy. In its front lines was the 2d Battalion, 6th Marines, with its machine-gun company and twelve light French tanks; with the 1st Battalion, same regiment, in the second line there were likewise twelve light French tanks and one machine-gun company, whereas the 3d Battalion, 6th Marines forming the third wave, had but one machine-gun company. The tanks were fired on by German machine-gun strong points, and checked in their advance, the strong points being located at the front and in the gap which at that time still existed between the two brigades. During the afternoon, the 4th Brigade and two companies of the 3d Brigade cleaned them out. While the 6th Marine Regiment was launching the attack with all its three battalions, the 5th Marine Regiment moved to the left into the sector evacuated by the former and followed in its wake, the 2d Battalion in the first, the 3d in the middle, and the 1st in the last attacking line.

During the forenoon, the 3d Battalion, 6th Marines, had already been obliged to occupy a front facing west, where they were opposite the Germans at Blanc Mont. The 2d Battalion, 5th Marines, now extended these lines to the left, and the 3d Battalion extended the lines of the 2d Battalion still further to the left, so that both battalions had fronts facing west.

After the 2d and 3d Battalions, 5th Marines, had formed for the attack, the 1st Battalion, which formerly had been in lines to the right of the 2d Battalion, 6th Marines, advanced along the Essen trench in a westerly direction. These battalions, during attacks in a northerly direction, had suffered severe casualties from the fire of the machine-gun strong point located on the left flank at the east spur of Helenen Hill, which the Americans had named "Essen Hook." This strong point, as well as a portion of the Blanc Mont sector, lay in the combat zone of the French 21st Infantry Division. This division, since 8:45 A.M., had vainly attacked the German positions at Marie-à-Py. To assist the French attack against this strong point, the 17th Company with one machine-gun platoon, one 37-mm. gun, and several tanks, now advanced from the east while the French attacked from the south. The 17th Company captured this strong point and evacuated it for the French who, in turn, again lost it during the afternoon. On this occasion the company captured one hundred prisoners. In the meantime the 1st Battalion, 5th Marines, which had advanced in a northwesterly direction, had swerved completely over to the west and now extended the line of the 2d Battalion, 5th Marines, to the left. To this point eventually the 17th Company also moved, so that now the left flank of the American west front was located approximately one kilometer north of the strong point.

As the attempt of the French 21st Infan-

try Division to advance against the German position had collapsed in its embryo stage under the German rifle and machine-gun fire, General Naulin, commanding general of the French 21st Army Corps, at 10:40 A.M. ordered the withdrawn French 170th Infantry Division to move into the rear of the combat zone of the American 2d Division and attack a line that extended from the west slope of Blanc Mont to the west slope of Sattelberg as far as the wooded terrain eight hundred meters northwest of the strong point. (See Appendix II.)* With this project General Naulin seemingly hoped to release the 4th American Brigade for further attacks in a northerly direction. This French 170th Infantry Division during the afternoon obtained contact with the 3d Battalion, 6th Marines, and the 2d Battalion, 5th Marines, both of which at that time formed the flank protection of the American 2d Division.

Complying with orders of the French 21st Corps, the French 21st Division during the afternoon advanced a mixed detachment, consisting of troops of the 21st and 151st Infantry Divisions, in an easterly direction as far as the Bromberg trench with orders to continue their attack from this point in a westerly direction. During the night these detachments recaptured the Essen strong point and subsequently reached the southeast slope of the Sattelberg where they obtained contact with the American troops. Thus we find here, to the west, throughout the entire afternoon and the following night, a fairly reliable and compact line until the withdrawal of the 5th Marines caused a gap of about one and one-half kilometers' width. At 11:30 A.M. the American 2d Division had reached its objective and established sentries in the outpost area.

Before we review the second attack of the American 2d Division which was launched during the afternoon, let us see what measures were taken by the Germans during this period.

As the harassing fire during the night had attained considerable volume, Group Py at 2:00 A.M. ordered the withdrawal of the assault detachment of the 149th Infantry Regiment, 213th Infantry Division, to a support position at Médéah Hill, and soon thereafter also ordered to a support position the assault detachment of the 74th Reserve Infantry Regiment at the Bémont Ferme. (See Appendix III).*

The American attack is pictured as follows:

> At about 6:00 A.M. a rather strong fire fell on the terrain in the vicinity south of Orfeuil and the sector of the 51st Reserve Division. The bombardment soon spread out over the entire front of the group. Under its protection, strong hostile detachments and tanks formed for the attack and about 8:00 A.M. penetrated as far as Blanc Mont, reaching the south slopes of Schlesier Hill, Médéah Hill, Steinberg, and Berlin Hill. Against this penetration, the group in the course of the day employed all available forces.

It appears that the completely exhausted front-line battalions were overwhelmed by the American attack. On October 2, 1918, the combat strengths of the 235th Infantry Regiment were as follows: 1st Battalion, 5 officers and approximately 150 enlisted men; 2d Battalion, 7 officers, 41 non-commissioned officers, and 177 men; 3d Battalion, 7 officers, 32 non-commissioned officers, and 194 men. These include officers and men of the machine-gun companies, signaling platoons and battalion staffs.

As no reports from him have been made public, I will quote the report of the regimental commander, 235th Reserve Infantry Regiment, forwarded at 8:00 A.M. and submitted by means of messenger dog:

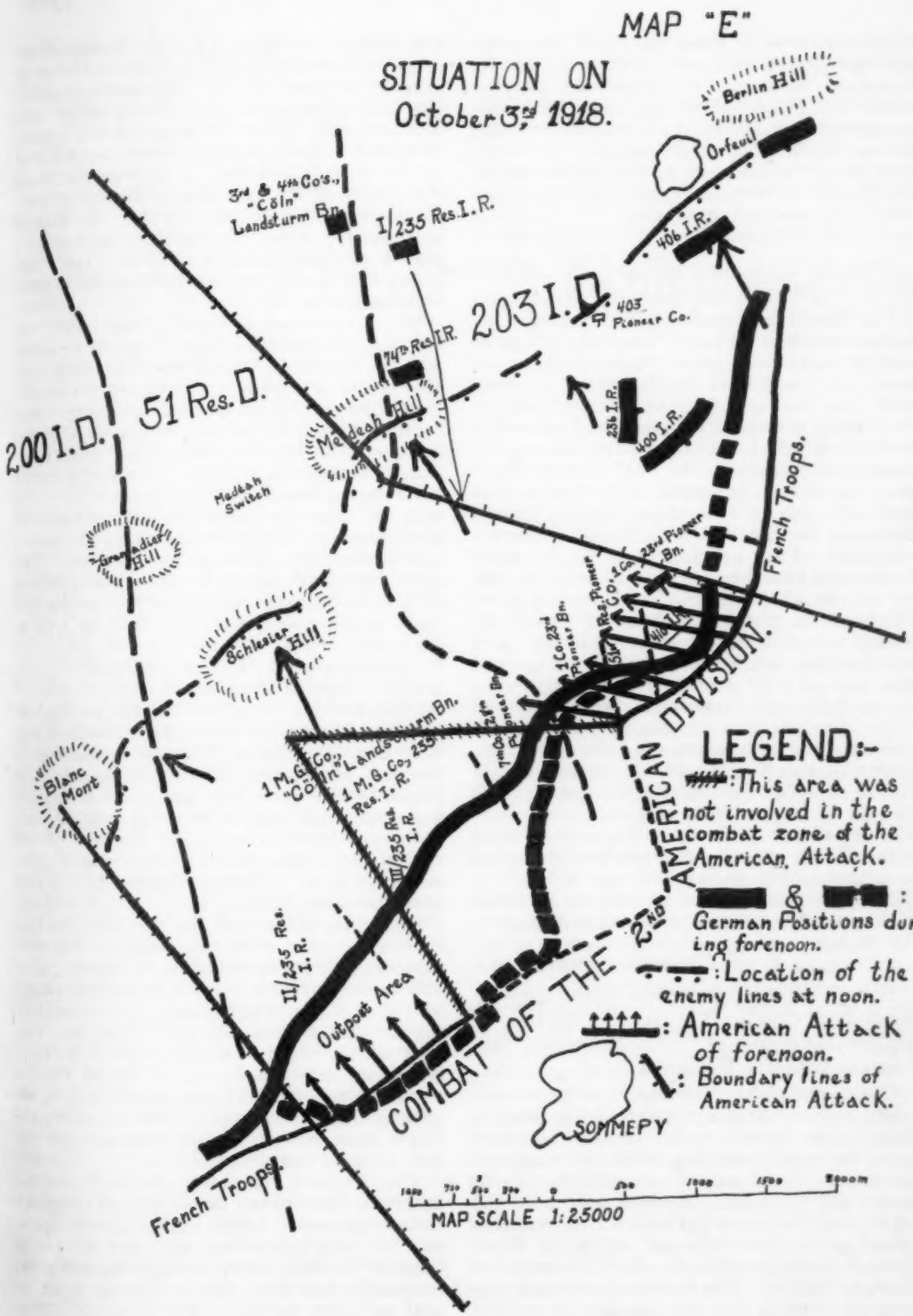
> Assistance is urgently necessary. Line Schlesier Hill–Médéah Ferme has been lost. Situation in regard to enemy still unclear. However, it appears that now he is already facing this line.

I have also the report of the regimental commander, 235th Reserve Infantry Regiment, which, at 9:15 A.M., he forwarded to the 102d Reserve Infantry Brigade:

> At 8:00 A.M. the enemy had possession of the crossroads on Médéah Hill; apparently he continues his advance east of the road. Schlesier Hill is now being subjected to serious attacks from an easterly direction. Within the line Schlesier Hill—halfway to Médéah Hill, there are located only the weak 1st and 4th Companies without a machine-gun company. It appears that at the present time this line is not holding its own. The regimental staff has shifted its command post to the vicinity of the

* Appendix II shows the scheme of relief of the American 2d Division and the neighboring right and left French divisions.

* Appendix III shows the order of battle of the Group of Armies of the German Crown Prince.


MAP "E"
SITUATION ON
October 3rd 1918.
Berlin Hill
Orfeuil
406 I.R.
3rd & 4th Co's.
"Cöln"
Landsturm Bn.
I/235 Res. I.R.
203 I.D.
403 Pioneer Co.
74th Res. I.R.
200 I.D.
51 Res. D.
Madeah Hill
Madeah Switch
235 I.R.
400 I.R.
French Troops.
Grenadier Hill
Schlesier Hill
23rd Pioneer Bn.
1 Co. 23rd Pioneer Bn.
1 M.G. Co. "Cöln" Landsturm Bn.
1 M.G. Co. 235 Res. I.R.
Blanc Mont
III/235 Res. I.R.
II/235 Res. I.R.
Outpost Area
COMBAT OF THE 2ND AMERICAN DIVISION.
SOMMEPY
French Troops
MAP SCALE 1:25000
LEGEND:-
: This area was not involved in the combat zone of the American Attack.
& : German Positions during forenoon.
: Location of the enemy lines at noon.
: American Attack of forenoon.
: Boundary lines of American Attack.

western portion of the airport and here concentrates fleeing elements of troops. Enemy appears to be satisfied at present with the possession of Médéah Hill—Schlesier Hill line. At the moment, I have at my disposal no more than six squads of the 235th Infantry Regiment. Have had no more news regarding the fate of the 2d and 3d Battalions, this regiment. Assistance is nowhere to be seen.

(Signed) DOERSTLING

This report is supplemented by another which was despatched at 11:30 A.M.:

The 2d and 3d Battalions, 235th Reserve Infantry Regiment and the Pioneer Battalion, as well as the two companies, appear to have got away with only part of their forces. They have been scattered in a southwesterly direction among the strips of woods and cannot be found. Returned elements of the 1st and 4th Companies, as well as the 403d Pioneer Company, have been employed as a thin reserve line in the terrain west of the highway toward Sommepy in Map Square 1250. They possess no power of resistance. Thus far, no reënforcements have been put in action in the sector of the 235th Reserve Infantry Regiment. The battalion of the 74th Regiment which yesterday was still on Schlesier Hill apparently has marched off, since it was no longer on this spot at 6:00 o'clock this morning. The enemy followed with tanks as far as Schlesier Hill. The presence of men in yellow-brown uniforms has been ascertained there. I consider the continuation of the attack in the course of today possible, as the enemy, with the aid of his countless airplanes, must have ascertained our weakness. The artillery now within the regimental sector has been instructed to retreat, with all its batteries, behind the thin infantry lines. The artillery on Schlesier Hill appears to have been captured in part by the enemy.

(Signed) DOERSTLING

A very vivid picture of the American penetration on October 3 is given by the following combat report of the 2d Battalion, 74th Reserve Infantry Regiment:

During the night of October 1 to 2, this battalion received orders to march from Königin Luise Lager [camp] to St. Etienne, at which point the assault echelon under the command of Major Streit was to concentrate. From here, the 5th and 7th Companies were branched off to Sattelberg for purposes of support and placed under the command of the 2d Jäger Brigade, later on under the direct command of Captain Stoffeld. The regiment, with one platoon of pioneers and one detachment of field artillery, moved to the "R-2 Position" and in it prepared for the counterattack, with the 3d Battalion at the right of the St. Etienne–Sommepy road, occupying a front line five hundred meters long, and the 1st Battalion occupying a corresponding section at the left of the road. The remainder of the 2d Battalion was located at a point five hundred meters west of the road as far as the path that leads from the small woods 139 at the St. Etienne–Sommepy road across Sattelberg to Marie-à-Py. Designated a counterattack reserve, the regiment had been placed at the disposal of the 2d Jäger Brigade; Half-Battalion Baudler was designated regimental reserve.

The second day of October was quiet. At 7:00 P.M. the regiment received orders to move, with its 1st and 3d Battalions, to Médéah Hill. Half-Battalion Baudler, reënforced by one platoon of the trench-mortar company, was ordered to remain where it was as a group reserve. The battalion despatched contact patrols to both flanks. To the right and forward there was a large gap, 750 meters wide. The very important Sommepy–St. Etienne road was now bared of troops as far as to the sector where the half-battalion was located. The latter therefore placed one and a half platoons of the 2d Machine-Gun Company on its left flank in order to protect this flank as well as the road.

Suddenly, at 1:00 A.M., October 3, the enemy delivered a severe harassing fire of medium and heavy caliber that fell on dugouts and trenches, especially on the Schwabenkönig road fork, the fire at 5:00 A.M. increasing to heaviest preparatory fire, while subsequently smoke bombs were also used. All telephonic communication was at once interrupted, and flash signals were impossible because of the smoke. At about 7:00 A.M. the regimental commander, 149th Infantry Regiment, together with the staff, hurried forward and met the commanding officer of the 2d Machine-Gun Company, from whom he obtained information regarding the situation of the battalion and to whom he, in turn, promised assistance of two additional battalions. Unfortunately, this assistance came too late. Even two runners of the regimental staff, 149th Infantry Regiment, despatched with a report for the commanding officer of the half-battalion, encountered dense masses of Americans on the Blanc Mont–Schwabenkönig road and were unable to carry out their mission.

The 5th and 7th Companies had received orders to launch their counterattack independently if necessary. Men authorized to receive and transmit orders and messages were with Captain Stoffeld under whose command the companies had been placed toward night, as well as with the 2d Jäger Brigade. They had been billeted much more comfortably than the men of the half-battalion. There were,

even if in insufficient numbers, dugouts available, which at the other sector were missing. Here at about 7:00 A.M. the noise of combat coming from the front lines was audible and orders were issued to occupy the positions. Hardly was the last man at his post when the enemy became visible, urging our men to surrender by waving at them. They had overrun the foremost lines with almost no resistance. Our machine-gun fire, which was launched at once in compliance with orders, brought their advance to a halt. But now the Americans, with the machine guns they had speedily brought into position, opened a furious fire that combed along the surface of the trench parapets. The company commander of the 5th Company, Lieutenant Soldan, as well as another officer, Lieutenant Louis, personally operated machine guns until jams rendered them useless. The bullets of our machine guns, easily finding their mark in the dense masses of the Americans, inflicted heavy casualties. Meanwhile the enemy, utilizing the gaps in our lines, had surrounded the 5th Company on its left flank, having advanced through the Freiburg depression and the dense shrubbery west of that company. They now launched another assault, advancing and firing their light machine guns which were operated, while carried by one man under his right arm, by another walking immediately behind. By the artillery bombardment, as well as the machine-gun fire, the company had already suffered bloody losses which amounted to at least 25 per cent. Attacked from the front and left flank, partly also from the rear, the remainder of the company, approximately twenty men, had to surrender. Only a few succeeded at the last moment in escaping and even a portion of these men was immediately mowed down by the ensuing pursuit fire. The company commander succeeded in reaching the battalion command post, from which point, standing and firing free hand, he shared in the defense against the overwhelming attack, until here too the envelopment of both flanks brought things to an end.

In the sector of the 7th Company, the enemy attacked in four strong waves with one portion of their assault troops advancing through the almost complete cover of the Freiburg depression, and the main body enveloping the left flank of this company. Here too, they were gripped in the fire of our light machine guns, which fired away to the last round provided they were not destroyed by a direct hit or put out of action by jams, and at first sought cover in the woods on the right and the left of the paths and clearings existing there. But now they began to roll up the position of the company from the left flank. After every last one of the hand grenades had been used up during this encounter, the platoon commander, Vice Sergeant Major de Riese, issued orders for evacuation of the sector. He concentrated the remnants of his platoon in a connecting trench of the barracks camp lying closely behind but was promptly forced to retreat even from here. Thereafter he placed himself and his men—eight musketeers and four machine gunners—at the disposal of the regimental commander, 22d Field Artillery Regiment, as a protective garrison for his guns then engaged in combat at the Pioneer Park.

In the sector of Half-Battalion Baudler the distribution had been planned to provide for both defense and counterattack. Thus the 6th Company had been placed in front of the 8th Company so that the men and machine guns of the latter were able to deliver a so-called overhead fire, there being a steep slope. One half of a machine-gun company protected the flanks within the second line. There was little visibility in this terrain as a result of the woods and dense undergrowth; thick smoke and dust clouds, as well as the artificial fog, also hindered the visibility. The trenches were occupied. One could perceive neither light signals nor the noise of the combat taking place in the front lines. Suddenly the commander of the 6th Company came rushing to the command post with the report that a moment before a wounded officer, the only one who had escaped from the front lines, had hurried past him saying that the enemy had entered the front lines. Immediately a patrol was despatched to secure and maintain contact with the commander of the front-line troops, 5th Reserve Jäger Regiment. Shortly thereafter, even before counterattacks could be started, strong detachments of Americans appeared on the right flank, advancing in the direction of Blanc Mont. They were immediately subjected to the fire of the two heavy machine guns on the extreme right flank of the battalion. But now the Americans appeared also at the front, supporting their advance from the direction of Sattelberg with machine-gun fire. Again they walked into a warm reception in the form of our rifle and machine-gun fire. This, however, was greatly weakened by the enemy's previous artillery preparation, which, by direct hits and splinters, had rendered useless about 50 per cent of the machine guns, there having been no opportunity to shelter them by bomb-proof dugouts. The light and heavy machine guns still intact after the bombardment were constantly employed on the flanks, so that there were but two useful light machine guns emplaced along the Blanc Mont–Schwabenkönig road at the time the Americans appeared there too. Our troops succeeded in clearing the road and in forcing them to retreat. But already the enemy, unmindful of the heavy losses suffered, had approached within a very short distance of

our lines. The battalion commander put into lines the men of the sub-staff under the command of Lieutenant von der Kammert, the machine-gun officer. They fired free-hand from the parapet of the trench. Despite all this, the Americans came forward until they were at a hand-grenade throw's distance, and also appeared again suddenly, this time greatly outnumbering our own men, on the right and left flanks where the trenches had been completely leveled by the artillery bombardment. They appeared also even in the rear. The Americans must have designated the Médéah Ferme–Blanc Mont Hill crest as their attack objective, because, had they pushed ahead regardlessly, not one man of our battalion would have been able to escape capture, not even by flight. Further resistance was out of the question, most of the light machine guns having fired their last round, and the half-battalion being surrounded on both flanks. Only a few men succeeded in escaping unharmed, closely pursued by airplanes that fired at random from a height of fifty meters, and their escape was made possible only by the dense shrubbery and by utilization of the changing range of the box barrage. The enemy had appeared at the Sommepy–St. Etienne road, cunningly utilizing the depressions, in extraordinarily superior numbers, according to some reports outnumbering our troops by twenty to one. Here, finally, our men, retreating at last, were forced to fight through the ring of enemies that gradually enveloped them.

On this day the battalion lost 8 officers, 44 non-commissioned officers, and 258 men, a portion of whom, mostly wounded, fell into the hands of the enemy. However, the losses of the enemy were also extremely heavy.

We have seen that the Americans encountered an especially tenacious resistance at the strong point located on the eastern spur of Helenen Hill, which they called "Essen Hook." It should be stated that this strong point was occupied by men of the 2d Company, 2d Cologne Landsturm Battalion. The battalion commander, Major Webendoerfer, reports as follows regarding the activities of his battalion:

In compliance with orders of Group Py, the companies were placed in the main line of resistance. The commencement of the hostile artillery bombardment on September 26 found the 2d Company in the sector of Division Etienne (the 200th Infantry Division), the 1st Company in the sector of Division Médéah (the 7th Infantry Division—later on the 51st Reserve Division), and the 3d and 4th Companies and the 1st and 2d Machine-Gun Companies in the sector of Division Orfeuil (the 15th Infantry Division), later also in the sector of the 203d Infantry Division.

The entrenchment activities of recent weeks have put a heavy drain on the physical abilities of the infantry companies, the members of which consist mostly of old men with little power of resistance. Despite this handicap, they have worked with admirable tenacity of purpose and have proved their worth and maintained their solidarity and self-possession even during the most severe artillery bombardment. Every hostile attack met the Landsturm men with their rifles in their hands at their assigned places.

After the battalion commander describes how brilliantly the companies employed at the Médéah Ferme and especially the ones at Orfeuil fought, he continues:

The 2d Company, too, has fought heroically and deserves the full recognition of the division under whose command it had been placed. Its company commander fell during an attack on a hostile tank.

The fact that separate companies were employed in the lines of strange units considerably impaired the value of their activities. Many officers and men expressed the opinion that had the Landsturm Battalion been employed in its own sector, under its own leader, and as an independent body of troops, it would have had no occasion to shrink back before even more difficult tasks.

It is particularly gratifying that this praise of the Landsturm men of Cologne was confirmed also by their enemies.

At 8:34 A.M. the assault detachment then located at Bémont Ferme (the 74th Reserve Infantry Regiment) was set in march to Blanc Mont in order to recapture the old German lines by a counterattack. This, however, the regiment was not able to do because, as we shall see, it was made use of at Médéah Ferme.

Even Army Headquarters, 3d Army, took a hand. At 8:35 A.M. it placed at the disposal of the group the Army Reserve, the 17th Infantry Division (minus the 75th Infantry Regiment), which at that time was located around Mont St. Martin and was scheduled to be transported to the Bémont Ferme via trucks. Group Perthes was ordered to direct the 89th and 90th Infantry Regiments to Orfeuil and the Bémont Ferme.

Group Py ordered the 17th Infantry Division to restore the situation by launching a counterattack on the boundary line between the 200th and 51st Reserve Divisions.

Courtesy Lieutenant Colonel Ernst Otto, German Army

GERMAN MACHINE GUNS

Being brought into position in a demolished house at St. Etienne.

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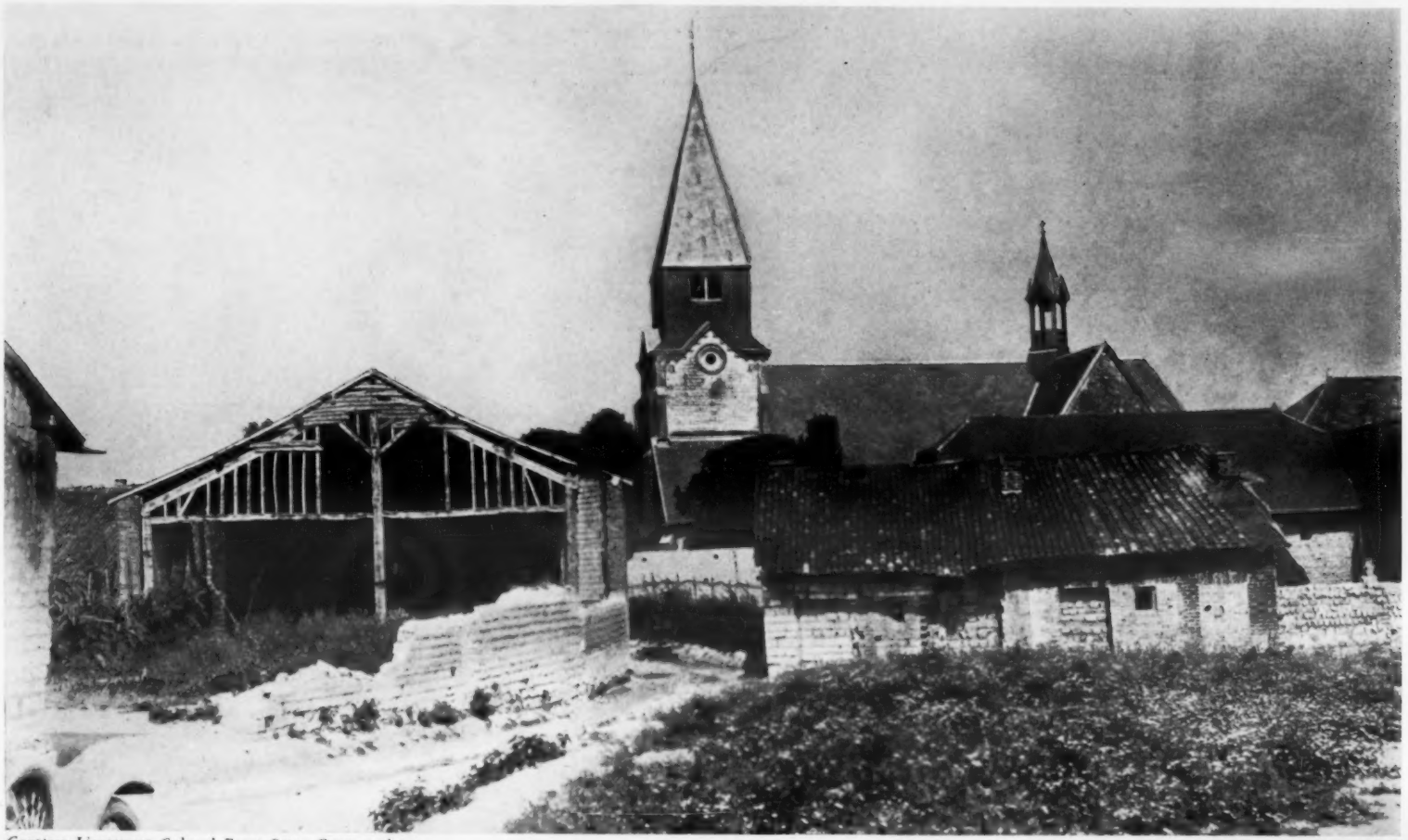

Courtesy Lieutenant Colonel Ernst Otto, German Army

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ST. ETIENNE

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GERMAN FIRE TRENCH ON THE EDGE OF ST. ETIENNE
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A STREET ENGAGEMENT IN ST. ETIENNE

The advance of the second German assault wave through the village on October 7, 1918.

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Courtesy Lieutenant Colonel Ernst Otto, German Army

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GERMAN INFANTRY

Fixing up a trench demolished by gunfire.

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RANK AND FILE OF GERMAN 2ND BATTALION, 74TH RESERVE INFANTRY REGIMENT

Retiring through the woods west of Blanc Mont after a valiant defense, October 3, 1918. They are being pursued by enemy planes, at which they wave so as to be taken for Americans and thus not be shot at.

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so as to be taken for Americans and thus not be shot at.
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ADVANCING GERMAN INFANTRY

In this case they use the file instead of skirmish line. The method of advance is left entirely to the leader, and should conform to the terrain.
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Courtesy Lieutenant Colonel Ernst Otto, German Army

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GERMAN ASSAULT DETACHMENTS
Rushing forward in a counterattack.
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At 8:50 A.M. the 15th Bavarian Infantry Division, relieved during the previous night, and badly exhausted at that, received orders to call up immediately all troops under its command and give them the following combat mission: blockade of the Third Main Line of Resistance in the vicinity of St. Etienne.

The right neighbor, Group Langer, likewise took a hand in the proceedings. At 9:30 A.M. it imparted information that it had occupied Hasenrücken and that it had set one battalion of the 7th Infantry Division in march to Petersberg. It further stated that the 14th Reserve Division was detraining at the railway terminal at Briquenay and was being transported into the vicinity west of Semide via trucks, at which point its arrival might be expected some time in the afternoon.

The forces thus hurriedly concentrated from all sides for the purpose of checking the penetration of the enemy were all put to use in the course of the afternoon.

We will now again go back and review the attack of the American 2d Division. From the commanding general of the French 21st Army Corps, General Naulin, it received orders to resume its advance but to allow one battalion to follow, echeloned, at the left. At 12:20 P.M., the left neighbor of the 2d, the French 21st Division, with the assistance of the 170th Infantry Division, succeeded in capturing the German trenches and pushed on to the northward.

The commander of the American 2d Division, Major General John A. Lejeune, at 3:00 P.M. ordered the two brigades to resume the attack until a line extending from Scay Ferme to the Blanc Mont–St. Etienne road, one kilometer south of St. Etienne, had been reached, to hold that line, and in addition to advance a line of outposts about one kilometer in front of the then main line of resistance. The commander of the 4th Brigade, General Neville, ordered the 5th Marine Regiment to carry out this attack, advancing through the lines of the 6th Marine Regiment. The commanding officer of the 5th Marines, Colonel Logan Feland, ordered that the attack was to be carried out in "battalion-columns," their order of march being the 2d, 3d, and 1st Battalions, and that it was to begin as soon as possible. The battalions, however, did not receive this order until between 7:00 and 8:00 P.M. Thus it was too late to withdraw them in time from their positions, in which they faced a westerly front. So the battalion commanders agreed among themselves that the attack was not to be launched before 7:00 A.M., October 4.

The commander of the 3d Brigade, located at the right, General Ely, at 3:30 P.M. ordered that at 5:00 P.M. the 23d Infantry Regiment was to advance through the lines of the 9th Infantry Regiment, with the latter subsequently following as a support. The slope one kilometer south of St. Etienne was designated as the attack objective. Even during the forenoon, the 23d Infantry had placed sentries forward as far as the outpost area of the 9th Infantry. At 5:30 P.M. the 1st Battalion, 23d Infantry, formed for the attack, the 2d Battalion following in the second line and the 3d, not until 6:30 P.M., advancing as the third line. The main attack was launched at 7:00 P.M.

Generally, the units of the 2d Division during this attack were able to advance only a distance of one and one-half kilometers; in the sector of the 1st Battalion, the attack objective was reached only at one single point and the troops immediately settled in some old training trenches found there. As both flanks were unprotected, the 2d Battalion, 23d Infantry, was drawn up and went into positions at the St. Etienne–Sommepy road as the protection of the left flank. Two companies reëstablished contact with the 6th Marines; the two others acted similarly on the other flank, establishing contact with the 1st Battalion, 23d Infantry. The 3d Battalion, 23d Infantry, was brought forward in an easterly direction so that, having taken up positions, it protected the right flank of the 1st Battalion, 23d Infantry. Behind this unit, the 2d Battalion, 9th Infantry, occupied a sector at the narrow-gage railway, east and west of Médéah railway switch, and also took up contact with the 2d Battalion, 23d Infantry. To assist it, the 3d Battalion, 9th Infantry, moved into the woods south of the Médéah railway switch and the 1st Battalion, 9th Infantry, moved into the trenches near Médéah Hill, establishing contact here with the French 167th Division. Consequently, at midnight a position had been reached and occupied that took the form of a triangular wedge. The 9th Infantry was located along the road that runs from the Médéah Ferme to the road crossing two kilometers southwest of the Médéah Ferme.

Rushing forward in a counterattack.
(Published by special permission from original war pictures)

The 23d Infantry was located between this road and Blodnitz Hill. The foremost battalion, however, lying opposite this hill, had contact neither on the right with the French 167th Infantry Division, nor on the left, with the 4th Brigade. The 5th Marines lay somewhat to the northeast of Blanc Mont, the 6th Marines south of it. The left flank of the 4th Brigade was still endangered by the German troops that had not yet been dislodged from the west slope of Blanc Mont. Into this somewhat uncomfortable position the American 2d Division had worked itself by reason of the fact that neither the neighboring French division on the right nor the one on the left had reached their attack objectives. Therefore, General Naulin, in his corps order of 6:15 P.M. (which was supplemented by another issued at 12:30 A.M.), ordered the French 22d Division to be placed in lines at the right of the 21st Division. Its instructions were to advance on October 4 through the right flank of the French 21st Infantry Division between Hohenzollern Trench and Landshuter Trench, and to attack in a northwesterly direction.

We will now see what took place on this day on the German side in the sectors of the 203d Infantry and 51st Reserve Divisions. (See Appendix IV.)* The night before, the 410th Infantry Regiment, groping along in the darkness in the sector of the 203d Infantry Division, had reached the northern German trench on Tor Hill, while the French were still holding their own in its southern portion. Since no contact existed on the left with the 409th Infantry Regiment the regimental commander, Major von Neuhaus, placed six companies behind his left flank and center as a reserve detachment.

On the third of October, the enemy—in this instance the American 3d Infantry Brigade—attacked at 6:15 A.M. After most terrific artillery preparations along the entire front, he penetrated the German lines in the sector of the 253d Reserve Infantry Regiment and west of the Sommepy–Médéah Ferme highway and continued his advance in a northerly direction. Simultaneously, strong hostile detachments (1st Battalion, American 9th Infantry Regiment) forced through the Rheinischer Grund to the northwest. They encountered the 2d Battalion, 410th Infantry Regiment, and defeated it after stubborn fights. The 1st and 3d Battalions, 410th Infantry, located on Tor Hill, were enveloped from easterly and westerly directions, and were either annihilated or captured. The 2d and 3d Batteries, 403d Field Artillery Regiment, drawn into the Gumbinner depression by the 410th Infantry, lost one platoon each; the 1st Battery, located at the Médéah Ferme, lost three guns to the enemy. From the Rheinischer Grund the enemy penetrated through this double ravine as far as Médéah Hill.

Simultaneously, the French attacked the 409th Infantry Regiment from the Bémont switch and the Jüterbog depression. On this occasion tanks were also used. The regiment repulsed the first attack and caused the enemy heavy losses; three of his tanks were destroyed. During the second attack the enemy entered the lines and gradually forced the regiment against Steinberg. In the sector of the 406th Infantry Regiment at Orfeuil the enemy four successive times hurled his forces against this front, being assisted by numerous tanks. He temporarily entered the village of Orfeuil but was immediately thrown out again in a counterattack launched under the personal command of the regimental commander, Major von Götz. All four of these attacks were completely repulsed, the enemy suffering the loss of many men and four tanks.

At 9:00 A.M. the enemy, in the sector of the 409th Infantry Regiment, had captured Médéah Hill; but the 1st Battalion, 409th Infantry Regiment, had been ordered to counterattack; Steinberg-Orfeuil and Berlin Hill were still held by our own troops. At about this time the enemy renewed his attacks against Médéah Hill and Steinberg, accompanying his efforts with a most terrific bombardment. Both hills were lost, but after our own artillery had delivered a bombardment of like volume, the 1st Battalion, 149th Infantry Regiment, coöperating with the 74th Reserve Infantry Regiment, recaptured them.

At the disposal of the 203d Infantry Division, which was now on its way to the front, Group Py had placed the 89th Grenadier Regiment of the 17th Infantry Division. This division had received orders to close the broad gap west of Médéah Hill which extended from here as far as Schlesier Hill within the sector of the 51st Reserve Divi-

* Appendix IV shows the order of battle of the German 203d Infantry Division.

MAP "F"
ORDER OF BATTLE OF THE ARTILLERY on the morning of October 3rd 1918.
Cauroy
Semide
Twel Taler Rücken
Victoria Hill
Scay Farm
3-12cm. Nay Cannon
1-21cm. mortar
St Etienne
Blodnitz Hill
Ludwigs-Rücken
Grenadier Hill
Schlegel Hill
Medeah Hill
Peters-Berg
Blanc Mont
Tor Hill
Sattel Berg
Belgian 7.5cm. Cannon
Dresden Hill
Leipziger Hill
Helenen Hill
Sommepy
Legend:-
: Field Gun Battery
: Field Howitzer Battery
: Anti Tank Battery
Field Artillery
: 10cm. cannon
: Heavy 12 cm. cannon
: Heavy 15cm. cannon
Heavy Artillery Flat Trajectory Fire
: Heavy Field Howitzer, Model 1908
: Long Range 21cm. Mortar
Heavy Artillery, Steep Angle Fire
MAP SCALE 1:25,000

sion. But, as there were signs of an impending attack against the sector of the 203d Infantry Division, this order was immediately amended and the 89th Grenadier Regiment was placed at the Bémont Ferme as a group reserve. One battalion of this regiment was placed at the disposal of the 406th Infantry Regiment because, meanwhile, a gap of about six hundred meters' length had developed between this and the 409th Infantry Regiment.

At about 5:00 P.M. the hostile attack against Steinberg and Orfeuil was in full swing, a great number of tanks participating. But at no point along the front did any hostile troops or tanks succeed in entering even our outpost positions. At several points, as for instance in the sector of the 406th Infantry Regiment, even the fire of our machine guns, themselves heavily shelled, prevented the advance of the hostile infantry. Here only the tanks were able to go forward, and when they noticed that their own infantry was not following, they turned about and retreated without having accomplished their mission.

This successful repulse reacted favorably on the morale of the men and it was, especially in the sector of the 406th Infantry, almost excellent. Steinberg, Orfeuil, and Berlin Hill remained completely in our possession.

Toward 5:45 P.M. the enemy expanded his attacks also against Médéah Hill. Here too, they generally ended without result. Only at a few widely separated points were the forward lines of the 74th Reserve and 409th Infantry pushed back on the north slope of the hill. As darkness fell, the regiments held the general line, north slope Médéah Hill–Steinberg–Orfeuil–Berlin Hill against repeated attacks during the morning and afternoon. The enemy had suffered heavy casualties, and seven of his tanks had been destroyed in our artillery fire. At 7:10 P.M. the 3d Battalion, 89th Grenadier Regiment, which had been placed at the disposal of the 406th Infantry Regiment, arrived in the Hirschgrund. The remainder of the regiment was still in the act of marching to Bémont Hill.

The 51st Reserve Division (See Appendix III), after the enemy had carried out his penetration of its lines, at 10:55 A.M. reported as follows to Group Py: "Schlesier Hill and Médéah Hill are being held." Corps Headquarters answered by telephone: "You will hold on to your last man. Reënforcements will arrive which will counterattack in a southerly direction. Every man who can carry a rifle will take part."

From the point of view of the 51st Reserve Division, however, its fate appeared most dubious. The operations officer of the division at 11:30 A.M. telephoned to the operations officer of Group Py: "There is scarcely a doubt that little is left of the 51st Reserve Division."

At 1:20 P.M. the 17th Infantry Division reported to the 51st Reserve Division that the 90th Fusilier Regiment was being brought forward in the direction of St. Etienne to launch an assault along the boundary line between the sectors of the 200th and 51st Reserve Divisions. It was said to be under orders to recapture Schlesier Hill provided it had been lost again, and to hold the Bémont switch on both sides of Schlesier Hill. It would take up contact at the right with the 149th Infantry Regiment north of Blanc Mont, and the 74th Reserve Infantry Regiment, located at Médéah Hill, at the left.

At 2:25 P.M., October 3, Army Headquarters of the 3d Army issued the following order:

It is most important that Group Py, by forward pressure of all its units, shall prevent an expansion of the hostile invasion west of the highway. Most energetic artillery fire will be placed on Blanc Mont, Schlesier Hill, and Médéah Hill. In expectation of hostile tank attacks sometime this afternoon and tomorrow morning, large quantities of horse-drawn field artillery will be placed at the disposal of the infantry regiments.

The commander of the 102d Infantry Brigade, Colonel Count von Ledebur, submitted at 4:00 P.M. the following telephonic report:

Remnants of the regiments are being concentrated at the Römerschanze. Brigade is of the opinion that 90th Füsilier Regiment must not attack but should simply endeavor to hold its own in the Médéah Hill–Grenadier Hill line. We can't carry on further, there's no combat value left in the infantry.

Various telephonic conversations now followed carried on between the operations officers of the division and group respectively, as to whether or not the attack could be effective with only the 1st Battalion of the 90th Füsilier Regiment participating and whether or not it should be carried out at all.

All doubts were definitely removed by the telephonic information submitted at 6:15 P.M. by the operations officer of the group: "His Excellency, Ludendorff, has called up. He demands that Schlesier Hill be captured."

Just how things stood with the 51st Reserve Division is clearly shown in an order that was forwarded at 1:15 P.M. to the officer in command of the trains:

You will concentrate every last man of the trains that you can spare. Leave only enough behind to enable the moving of the trains. Equip them with arms, ammunition, and a supply of food, at least enough for a number of days. Divide them into companies under guidance of officers and non-commissioned officers. March them off at once to divisional headquarters at Leffincourt.

At 7:50 P.M. the 51st Reserve Division issued the following order to the 90th Fusilier Regiment:

Group Py orders as follows: The hostile elements who have broken through will be attacked from the line of departure Petersberg–St. Etienne–Blodnitz Hill. Neither darkness nor attacks of small hostile detachments which have broken through will prevent the 90th Füsilier Regiment from carrying out its mission and final attack objective: "Recapture of Schlesier Hill." The accomplishment of this task is the more important since, west of the highway Semide-Sommepy also, two battalions of the 89th Grenadier Regiment are now advancing with whom contact is to be established.

In this way were speeded forward the attacks against the American 2d Division, which had broken through.

But who actually did intercept the advance of the Americans in the direction of St. Etienne? To this question the War Diary of Group Py (Corps Headquarters, 12th Army Corps) gives the following answer:

In many combats of swiftly changing issue Blanc Mont, Schlesier Hill, Médéah Hill, Steinberg, and Orfeuil were repeatedly lost to the enemy and recaptured by our own troops. At 5:00 P.M. Blanc Mont and Schlesier Hill were again in the hands of the enemy. Penetrated elements lodged between Ludwigs Rücken and Etienne and south of Blodnitz Hill. They were checked in their further advance by the 15th Bavarian Infantry Division and elements of Group Langer which had blockaded the Petersberg–St. Etienne line.

Even as early as 3:40 P.M., the 31st Bavarian Infantry Regiment, assembled from men who were still able to fight, under the command of Major Reiss, had occupied Blodnitz Hill. Among these combats, the following act of heroism stands out:

Vice Sergeant Major Kohnle of the 1st Machine-Gun Company, 31st Bavarian Infantry Regiment, on October 3 had been ordered with his platoon to occupy the southeast slope of Ludwigs Rücken. When, advancing in dense masses, the Americans descended the slopes of the hill opposite them, he quickly opened fire and kept it up until the enemy, rushing forward with death-defying carelessness, approached within a few meters of his gun, which he was personally operating as gunner. Suddenly his gun received a direct hit. It was not, however, damaged too badly to prevent his firing away the last round of ammunition. At the same moment he noticed that the enemy had come around him on one side. With lightning-like decision he grabbed his hand grenades, hurled them against the enemy, and was thus able to delay them long enough to allow him to shoulder his machine gun and withdraw into the designated retreat position.

We shall see how successful was this regiment under Major Reiss on October 4 in its efforts to ward off the American attack.

We come now to the combat activities of the 200th Infantry Division (See Appendix V).* Formerly, the command post of this division was located on Blanc Mont. In it were now located artillery staffs and the orderly officer of the division, First Lieutenant Richert.

This officer at 8:15 A.M. telephoned to Division Headquarters, to whom reports concerning the vicious fire and the advance of the hostile infantry behind tanks had been previously made, as follows: "The enemy has reached the top of Blanc Mont. We can hear them talking above." The operations officer answered him: "Hold out as long as you can."

In another dugout on Blanc Mont sat the staff of the Jäger Brigade, who, however, were not able to despatch messages. But the 3d Jäger Regiment at 8:26 A.M. telephoned, "All attacks repulsed." It received instructions: "Take everything at your disposal and employ them at the left where it is necessary that you block the advance." First Lieutenant Richert reported at 8:30 A.M.: "The Americans are now sitting on top of the command post and have led away

* Appendix V shows the order of battle of the German 200th Infantry Division.

a third of our men as prisoners. Someone says that they have moved off this minute."

First Lieutenant Richert (8:48 A.M.) speaks again (a number of carrier-pigeon messages regarding the American attack having reached the division): "According to reports from the 4th Jäger Regiment, it appears that every attack against our front has been repulsed. Strong hostile columns of infantry, following in the wake of tanks, are advancing from Sommepy in a northerly direction. We are opposed by only one battalion located on both sides of the cable trench."

The answer comes: "You will simply have to grab troops of some sort, perhaps the 149th Infantry Regiment, and restore the situation." First Lieutenant Richert replied: "Very well, sir. I'll collect every available man and occupy Main Line of Resistance No. 3."

Following further carrier-pigeon reports received by the division to the effect that all attacks against our front had been repulsed, Lieutenant Richert again communicated: "Our own officers have occupied the entrance to the dugouts. Presumably the enemy has halted at the highway. He has now but weak sentry posts on Blanc Mont." At 9:08 A.M. he resumed: "Hostile reënforcements reported as being in advance from Holsten road and Rensburger road; artillery fire requested on these points." This request was complied with. However, from 9:24 A.M. on, messages ceased to come in from First Lieutenant Richert. But one telephone operator quickly yelled to the man at the other end of the wire: "The Americans have sent one of their men down into the dugout, who is demanding our surrender." Thus the Americans captured here, in addition to Lieutenant Richert, the entire staffs of the artillery long-range and close-combat weapons, one officer of the Scout Detachment, one pioneer officer, a number of telephone operators, wireless men, pioneers and Uhlans. In contrast, the staffs of the Jäger Brigade, hidden in another dugout, managed to escape in the nick of time.

Notwithstanding this, division headquarters at 10:00 A.M. received the following carrier-pigeon report, despatched by the 149th Infantry Regiment: "Elements of the regiment have arrived at a point south of Blanc Mont, which is still in our hands, and are forming the defensive flank from Blanc Mont to Ludwigs Rücken." Ten minutes later the 200th Infantry Regiment ordered the following wireless to be distributed to all regiments: "Positions in the front will be held at all cost. Sufficient reënforcements are on the march to protect the left flank."

And there was still another message from Lieutenant Richert. Wild rumors were afloat, and therefore, shortly before he was captured by the Americans, he had ordered a motor-cycle courier to race through to the rear. This man correctly brought an instruction from the division, directed to the brigade: "The division informs us of the following: according to a scout's report, the enemy is said to have penetrated our lines as far as Sattelberg (the hill south of Blanc Mont). Do you have any new reports at Brigade Headquarters? What reports have you from Stoffleth?"

The adjutant of the Jäger Brigade was at 10:24 A.M. able to report:

> Brigade staff has managed to escape from Blanc Mont. Colonel Lehmann is located on Petersberg. Three-quarters of an hour ago Captain Stoffleth reported to us that he was holding the east edge of Sattelberg. The regimental staff of the 149th Infantry Regiment is located at a point north of Sattelberg; one battalion has been ordered to envelop Blanc Mont in an attack from the north. There is little doubt that the 2d Battalion, 74th Reserve Infantry Regiment on Schlesier Hill, has been overcome. Everything seems to be in order to the south of us. On Blanc Mont Americans are located. (6th Marine Regiment of the American 2d Division.)

It was now decided to withdraw the 74th Reserve Infantry Regiment from its sector near Bémont Ferme in order to advance against Blanc Mont. But this was not possible because the regiment had already launched an attack against Médéah Hill. However, as the left flank of the Jäger Regiment at about 10:13 A.M. had been forced back as far as Holsten road, it was decided to place at its disposal the 1st Battalion of the 368th Infantry Regiment of Group Langer for the protection of its left flank. But at 10:25 A.M. the 4th Jäger Regiment had warded off a hostile tank attack and blocked the terrain on the left at Kaiser road with the pioneers of the 105th and 282d Pioneer Companies. Still, contrary to all reports, it seems that at 10:25 A.M. Sattelberg was in the hands of the enemy.

In the meantime a battalion of the 165th Infantry Regiment of Group Langer occupied Petersberg.

The situation in the sector of the 200th Infantry Division was now such that its right flank held Marie-à-Py and the positions south of the Py brook, while its northern or left flank was continually pushed back. After it had been ascertained that the 90th Füsilier Regiment, which for purposes of recapturing Schlesier Hill was to advance in attack between the 200th Infantry and the 51st Reserve Division, could not arrive before 2:00 P.M., Group Py instructed the 200th Infantry Division at about 1:10 P.M. as follows:

If possible, begin now to withdraw your elements from the southern to the northern bank of the Py brook in order to protect your left flank. Objective for the day: capture of Blanc Mont and Schlesier Hill. Objective for the night: withdrawal of your troops as far as the point of contact with your right neighbor on Hasenrücken.

Hereupon the operations officer of the 200th Infantry Division replied: "Impossible to carry out this withdrawal during the day." At 1:59 P.M. Captain Stoffleth had recaptured Sattelberg, assisted by the guns of the 17th Machine-Gun Sharpshooters' Detachment and the 2d Machine-Gun Company, 18th Jäger Battalion. At his left, he was in contact with the 149th Infantry Regiment on Blanc Mont. Of this regiment, however, there were located at this point only the regimental staff, two battalion staffs, three companies, and one machine-gun company. At 2:18 P.M. the division stated that it was not enough that the 149th Infantry Regiment should occupy Blanc Mont, where meantime the wireless station of the division had also been re-erected, but that the regiment should also capture the trenches on its east slope and then participate in the attack of the 90th Füsilier Regiment against Schlesier Hill.

The location of the Telephone Detachment on Blanc Mont was far from comfortable. This we can see from Lieutenant Felten's report at 3:38 P.M.: "The Americans on this point are located only thirty meters from our dugout. Here are two companies of the 149th Infantry Regiment. It is a question whether they can hold out much longer."

By 3:58 P.M., Captain Stoffleth with his troops had again been forced from Sattelberg. He held on at the west slope. From here to Blanc Mont there was a gap through which the Americans had filtered, and tanks had been seen at Blanc Mont. Elements of the 18th Jäger Battalion still held their own in Kaiser trench, north of Sattelberg. Two companies of the 168th Infantry Regiment had been placed between the sector of Stoffleth's Battalion and the Second Main Line of Resistance.

When, at 4:20 P.M., the enemy launched another attack against Marie-à-Py, it was impossible to despatch reënforcements to the troops at that point; they were instructed to hold the town until nightfall, when the line was to be withdrawn in any case. But matters were soon much worse on the left flank. A carrier-pigeon report from the Jäger Brigade, despatched at 6:00 P.M. and received by the division a half hour later, stated:

To judge by the noise of combat, the enemy has penetrated a good distance to the north beyond Schlesier Hill. Captain Stoffleth—fifteen men are with him—lies at the point where Kaiser road converges with Main Line of Resistance No. 3. He is without ammunition. The 149th Infantry Regiment has occupied this line at a point south of Numeral 210; east of 210, the enemy is lodged within our main line of resistance. The 149th has in addition several machine-gun strong points east of the St. Etienne–Blanc Mont road, but has at its disposal only three companies and one machine-gun company; the remainder of the regiment has not yet been found. The serious shortage of ammunition and depleted number of troops make it at present impossible to launch an energetic counterattack. Major von Bülow of the 4th Jäger Regiment will now roll up that portion of Kaiser road which lies between the Main Line of Resistance No. 2 and Sattelberg and is thickly occupied by the enemy, but up to 4:45 P.M. he has not yet been able to get the 3d Battalion, 368th Infantry Regiment, to the front lines for that purpose. To judge by the noise of combat, the enemy has now reached the vicinity of Ludwigs Rücken. Not possible to tell from here whether or not he is engaged with our own troops that were advancing in that neighborhood. The 149th Infantry Regiment tells us that there were also Frenchmen located on the eastern portion of Blanc Mont. They have captured prisoners of the French 99th Infantry Regiment.

The divisional observer ascertained that at first our own troops retreated from Ludwigs Rücken, freshly advancing German

troops recaptured that hill, and finally it fell again into the hands of the enemy.

From the 15th Bavarian Infantry Division was received at 6:57 P.M. the following report: "Fight around Blodnitz Hill going on." Here is the next report, of 7:30 P.M.: "The enemy is located on Ludwigs Rücken; advances against St. Etienne where the 32d Infantry Regiment is now being placed in lines. Blodnitz Hill in our hands." Still another report of 8:51 P.M. states: "We have finally lost Ludwigs Rücken Hill. Strong enemy forces now feeling their way forward against Etienne. We are too weak to hold this point longer (eighty men)."

The loss of Ludwigs Rücken had rendered the situation of the 200th Infantry Division extremely difficult. At 9:02 P.M., the operations officer telephoned to the group: "I doubt very much that the 90th Füsilier Regiment will be able to capture Schlesier Hill; at any rate, we can hardly remain on Blanc Mont. The enemy will attack through the 'hole' at Ludwigs Rücken and advance upon Machault and Cauroy." At 9:30 P.M. he conversed with the operations officer of Group Py:

Tomorrow morning we will have the 149th Infantry Regiment on the left flank, with one battalion in reserve. Battalion Stoffleth is wiped out. Artillery is beating its way back via Pierre-à-Arnes. Tomorrow the 7th Infantry Division will also have to attack from Petersberg. We simply must have Ludwigs Rücken back. If extremely lucky, the 90th Füsilier Regiment may be able to connect with Blodnitz Hill, but never with us. *First of all*, we need a solid line which we will find in Petersberg—Ludwigs Rücken—Blodnitz Hill, and then we will be able to attack the enemy from the south tomorrow.

At 9:50 P.M. the following order was forwarded by the division to the Jäger Brigade:

The two battalions of the 368th Infantry Regiment which we have promised you will not come. Early tomorrow morning, the 4th Jäger Regiment and the 149th Infantry Regiment will eventually assume a front to the north, in the direction of Ludwigs Rücken. Blanc Mont will be held.

Of the recapture of Blanc Mont on October 3, the regimental commander, Major Gründel, 149th Infantry Regiment, gives the following account:

Hurrying forward far ahead of my troops, I reported personally at 6:30 A.M., October 3, to the command post of the 2d Jäger Brigade and was given the following orientation and impressions in regard to the combat situation: Only a few negligible remnants of the 18th Jäger Battalion are located on Sattelberg, warding off strong attacks from the south. They have no contact to eastward and in particular are uncertain whether Schlesier Hill is still in our hands.

I personally obtained additional information in regard to the latter question when I repaired to Battalion Headquarters, 3d Battalion, 74th Reserve Infantry Regiment, located on Schwabenkönig, where, at 7:50 A.M., I found Captain Baudler. With his battalion staff, he told me, he was fighting only for the possession of his command post. The enemy had overcome his battalion on Schlesier Hill and now pressed forward in the direction of Grenadier Hill. From this point I hurriedly rode back to Blanc Mont and despatched mounted messengers to the batteries and the 2d and 3d Battalions of the 149th Infantry Regiment, whose arrival from Russenkreuz was expected. They had been less fortunate in their efforts to rush through the box barrage which, since 5:30 A.M., had covered the rear area, than I had been with my battalion staff.

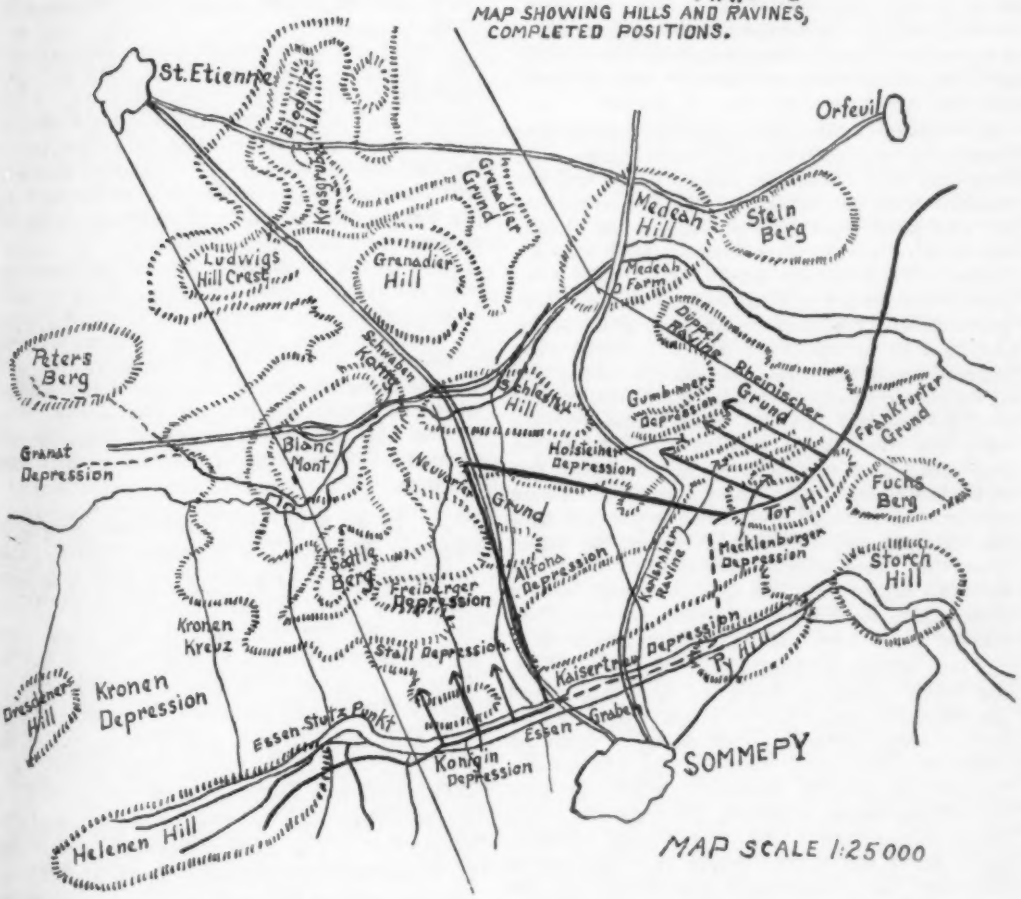
At 8:30 A.M. Captain Sassenberg arrived with the advance guards of his battalions. By 9:00 A.M. the staff, 2d battalion, 149th, the 5th, 6th, 7th, and 8th Companies, the 2d Machine-Gun Company, and the 10th Company were on the spot. All companies had suffered losses in the strong box barrage which they had had to contend with ever since they left Russenkreuz. The most severely hit of all, the 6th Company, 149th, arrived here only in platoon strength. At 9:00 A.M. the situation had developed as follows: Since about 8.15 A.M. the command post had been shifted from Blanc Mont to the rear. On Blanc Mont were elements of the 18th Jäger Battalion amounting to about twenty men with three machine guns, the latter without ammunition, barely able to stick to the northwest slope, and hard pressed by the enemy who dominated the heights. In contact to eastward: 2d Battalion, 74th Reserve Infantry Regiment, which was practically annihilated. Here a strong enemy force was in the act of advancing from Schlesier Hill across Grenadier Hill in a northerly direction; other detachments, rushing along the highway from the east, were advancing against Blanc Mont.

With this situation in mind, I ordered the 2d Battalion, 149th, with the 10th Company, to counterattack along both sides of the highway Blanc Mont–Schwabenkönig, with the front to the northeast. In an energetic assault, the knoll of Blanc Mont was torn out of the hands of strong enemy forces by the 5th Company, 149th, and occupied. The 8th Company following up the 7th Company, with the remnants of the 6th

Company on both sides of the highways, and the 10th Company on the northern or left flank, advanced quickly and brilliantly, but, after having penetrated the wooded terrain on both sides of the highway to a distance of about three hundred meters, they encountered so superior an enemy that they were forced to halt, front to the east, and take up the defensive. Consequently the north flank, in this wooded terrain where observation was very limited, was completely "in the air." It was, moreover, from the beginning on overrun by the enemy, who outnumbered our troops five to one, and there was nothing to prevent them from enveloping it since all available troops had been employed in the front lines. No reserves were available, the bulk of the 3d Battalion, 149th, was still a long way off. The most critical danger to this flank was overcome by placing there also the advance guards of the 3d Machine-Gun Company which had arrived around 11:15 A.M. Captain Schmidt, commander of the two accompanying batteries of the 2d Detachment, 272d Field Artillery Regiment, arrived at 9:45 A.M., having hurried far ahead of his troops; his batteries did not arrive here before noon.

Thus my greatly weakened infantry (only four and one-half companies strong) opposed for hours an enemy assaulting from all sides, and who, on the north flank, was all ready to envelop the sector. Among other methods employed in his attacks, the enemy directly at the beginning of the affray used two tanks and a number of low-flying combat planes, which, however, vainly sought to break our resistance. Unopposed by any German troops, the Americans farther to the east, leaving Schlesier Hill behind them, were resuming their advance upon St. Etienne and could reach our flank and the rear by way of Ludwigs Rücken at any moment. With the still available guns of the 3d Machine-Gun Company we immediately began to lay a barrage from a permanent machine-gun position located somewhat to the northwest. More,

MAP "G"
MAP SHOWING HILLS AND RAVINES, COMPLETED POSITIONS.



however, could not be accomplished at that time in the way of protective measures for the rear and the flank.

All of which makes it clear that the original situation in which the regiment found itself at 9:00 A.M., October 3, contained the core from which later developed the almost complete encircling of Blanc Mont by our troops. What was needed was the participation of forces from the rear in the direction of Ludwigs Rücken in order to somewhat relieve the regiment in its flank and the rear. Enough, I believe, had been demanded of the weakened elements of the regiment when, as we have seen, it had withstood all assaults against Blanc Mont until the reënforcements from the rear rendered effective assistance.

Around noon, the 18th Jäger Battalion was completely exhausted. Its wretchedly weak remnants had evacuated Blanc Mont and the western point of contact, by this action throwing also upon my regiment the burden of taking care of the western contact with the 4th Jägers. This contact would never have been established had not finally the 3d Battalion, 149th Infantry Regiment, arrived about noon. On its way to the front it had suffered even heavier casualties than the 2d Battalion, and of its 9th Company especially there was left but a pitiful handful of men. Thus I was provided with only two companies with which to fill the gap created on my right by the dropping out of the annihilated 18th Jäger Battalion. These two companies were established in contact with the 5th Company, 149th, in lines fronting south. Here they were at once subjected to heavy attacks from the direction of Sattelberg, but on their right flank they at least succeeded in making contact with the 4th Jäger Regiment.

Thus, within a limited part of Blanc Mont, the 149th Infantry Regiment now dominated the situation, since this brilliant troop had no fear of enemy attack and envelopment from the front, and five times, with no help whatsoever, warded off hostile attacks. With its own limited resources, however, the regiment could do nothing against the threatening envelopment from the north, where the dominating Ludwigs Hill, completely abandoned by our troops, offered opportunity for enemy use.

If the enemy on October 3, did not swerve his forces from the direction of Ludwigs Rücken against our own sector, it was simply because he already looked upon us as sure prey.

At 3:00 P.M. the commanding general, General of Cavalry Krug von Nidda, issued the following group order:

During the coming night, the 1st Army, together with Group Langer, will withdraw into the Brimont-Berru position and will establish contact with the 200th Infantry Division by way of Martin switch position.

As darkness falls, the 200th Infantry Division will shift the bulk of its forces into the Third Main Line of Resistance. Covering parties now in the present outpost area will follow the withdrawal of Group Langer, beginning at about midnight, and will then withdraw into the Dresdener Hill–Kronenberg–Sattelberg line. This will form the foremost line of the outpost area; patrols will remain in the First and Second Main Lines of Resistance.

On October 4, the group will hold its positions.

Having been designated Army Reserve, the 55th Infantry Regiment of the 13th Infantry Division, with attached field artillery, in the evening will relieve the 75th Infantry Regiment of the 17th Infantry Division in its position at the Sachsen-Kuppe (knoll). The 75th Infantry will place itself in support at a point south of the Bémont Ferme and will there be under the command of the 17th Division.

Two thirds of the 89th Grenadier Regiment, with the attached field artillery, will place itself in support at a point west of the Bémont Ferme, its third battalion remaining north of Orfeuil.

With its attached field artillery, the 90th Füsilier Regiment will place itself in readiness north of Blanc Mont as an assault troop.

The 15th Bavarian Infantry Division will move into the vicinity of Etienne as the Group Reserve.

At 10:45 P.M. the commanding general ordered that the 51st Reserve Division was to continue on October 4 its attack against Schlesier Hill. Finally at about 11:30 P.M. he ordered the shifting of about one-third of the assault troops of the 1st Bavarian Infantry Division to Etienne, of portions of the 15th Bavarian Infantry Division to Blodnitz Hill and Etienne, and of elements of the 7th Infantry Division to Petersberg. The 200th Infantry Division was ordered to hold Blanc Mont and the main line of resistance west of it. The 51st Reserve Division was to attack at daylight with its right flank advancing across Grenadier Hill, the objective being Schlesier Hill. The 7th Infantry Division was to attack Ludwigs Rücken from the west, the 15th Bavarian Infantry Division was to attack it from the northwest, while the 200th Infantry Division, throwing all its available resources into lines, was to attack it from the south.

Telephone conversations between general staff officers of the divisions and the group continued, however, throughout the night. In a conversation with the operations

officer of Group Py at 11:47 P.M., the operations officer of the 200th Infantry Division said: "The Blanc Mont–Etienne road is free of the enemy. Presumably they have advanced along the Sommepy-Etienne road and have turned more to the north than to the west. On Petersberg are located our own troops, the 5th Jäger Regiment and elements of the 165th Infantry Regiment. *As for ourselves,* we can make no further attack. Two battalions of the 368th Infantry Regiment have been directed to march to a point north of Etienne—by whom, I do not know. This division has now a total strength of only about five hundred men, all of whom are physically worn out. Just a minute ago Group Py sent us an order to the effect that the two battalions of the 368th Infantry Regiment and one battery would be at Petersberg tomorrow morning after all." To this the operations officer of Group Py answered: "With these you can attack tomorrow morning and take Ludwigs Rücken." This brought forth the reply of the operations officer, 200th Division: "Some time or other you simply will have to relieve the troops or else we shall lose all our good officers and Jägers." At this moment the chief of staff of the 3d Army picked up the receiver and declared: *"We are now dealing with a matter of most serious political nature. The left flank of the 1st Army must remain secure. This means that we must take possession of Blanc Mont!"*

It was plain to all divisions concerned that, on the next morning, a new major attack would have to be reckoned with. The rushing to the front of strong reënforcements had been reported; and there was also information that a cavalry regiment with a large tank squadron had been placed in support at Sommepy. The divisions were of the opinion that, confronted with such an attack, a solid front was needed; to waste the last good troops would be folly.

On October 4 the commanding general of the 3d Army, General-Oberst von Einem, distributed the following order by telephone:

> For their tenacious resistance during yesterday's repeated assaults of a numerically superior enemy, and the aggressive spirit manifested during counterattacks I wish to express my sincerest appreciation to the valiant divisions of Group Py.

It is most astonishing how the brave Jägers of the 200th Infantry Division were able to resist the French divisions that advanced on their sector from the south and east, and protected the strong masses of artillery located immediately behind them (See Map F). This feat is the more worthy of admiration when one scans the report which on October 2 was forwarded by the commanding officer of the 2d Jäger Brigade to the 200th Infantry Division:

> The troops under my command have again fought without rest through a hard day, completely repulsing an attack preceded by terrific artillery bombardment, and inflicting heavy losses on the enemy. Twenty-seven prisoners remained in their hands. All this the battalions accomplished despite their depletion to pitiful remnants, and despite the fact that their mental and physical strength was sapped to the last ounce. It may be considered certain that the enemy, for a number of days at least, will continue to launch his attacks, which, in view of the growing depletion of our own forces, and the flanking thrusts at the left which hourly assume more threatening proportions, it will be increasingly difficult to oppose. Despite the satisfactory morale still prevailing among the men, it is to be feared that some day their physical strength will suddenly snap as a result of overstrain and exhaustion, and thus the last remnants of the regiment will be annihilated. *Penetration by enemy forces of the Second Main Line of Resistance would then be inevitable, with the very probable loss of the artillery located behind the sector.* I am convinced that this moment is close at hand.
>
> Moreover, it is to be feared that, through a continued employment in lines, the last officers, Oberjägers and Jägers, of the old school and active service, to whose training and influence must be accredited the present excellent morale of the troops, will be also lost. And still further, it is to be feared that, in the event of the aforementioned failure of strength, the excellent reputation of the Jägers, which has been further increased by the recent combats, will be lost, and in the end, instead of well-deserved appreciation for previous achievements, blame will be heaped on their heads for the final defeat.
>
> In view of these considerations, I regard it my duty to recommend the quickest possible relief of the regiments under my command.

On October 2 the combat strength of the brigade, including the 7th Company, 234th Infantry Regiment, and the 2d Company, Cologne Landsturm Battalion, consisted of 885 men with 50 heavy and 23 light machine guns and 5 trench mortars.

(To be continued in the next issue)

A Plea *for* Talking "Shop"

By LIEUTENANT JOHN F. MADDEN, *U. S. Navy*

WHO is not familiar with the ever-present group of watch-standers who, after the movies, congregate in the wardroom and there with their heels up higher than their heads, hand down decisions on such matters as may come under discussion? This group is generally either tolerated or denounced, but seldom praised. They should, however, receive recognition for their contributions to what we may broadly term experience.

Here is a term, a phase of naval life if you like, which we are continually running afoul of in its many applications. The young ensign, newly graduated, reports aboard his first ship fired with a determination to do big things in a big way, to make his mark—in short to do his job and do it well. These people, for the most part going to battleships, draw their routine assignments and immediately find their progress toward their goal assuming almost snail-like speed. They do what is given them to do, but beyond that they find the going slow because they lack experience. The term constantly recurs, as witness a few examples:

"Send Jones on patrol, it will be good experience for him."

"Send the J.O.'s over to observe spotting practice, it will give them a little experience."

"Smith would be a good man for the job, but has he enough experience?"

"Damn it, young man, I stood boat-officer watches in a frock coat and I consider such details good experience."

Daily the J.O. has this matter of experience brought to his attention and in a good many cases it leaves him bewildered. The usual procedure followed by a young officer, finding himself without something that he needs, is to turn in an "in excess" requisition for it. Unfortunately, in the case of experience this method fails him.

What, after all, is experience? The dictionaries give it as being the acquiring of knowledge by use of one's own faculties of sense and judgment, or the knowledge so acquired; especially the state of such knowledge in an individual as an index of wisdom or skill. Fundamentally, then, experience is knowledge. It is knowledge acquired by the exercise of one's own personal sense and judgment. Further, such knowledge when acquired is an index of wisdom or skill. To simmer it down still further, you gain experience by the things you do and have done. I submit that you also gain experience from the things other people do and have done. Of all professions engaged in by men, I can think of none where this fact is more pronounced than in the Navy. An officer reaching command rank is experienced without question. He is fortified by knowledge obtained over a span of thirty years or more, during which time he has held many positions, discharged many duties, and met many emergencies. He is further fortified by the knowledge of what others have done. The source of this knowledge is the experiences of those who have gone before him and those whose service and experience are contemporary with his. Both these sources are important. To become experienced, in the broad sense, neither may be neglected. Using personal experience as a basis, the experience of others broadens and widens the field, so that in the last analysis the experiences of others may, in effect, be considered as if they were our own. It is on this premise that I base my plea for talking "shop."

To dwell for a moment on the talking of "shop" as such. By this we mean, largely, the discussion *out* of working hours of the various tasks, in their many phases and applications, which occupy our time and attention *during* working hours. It is held by many that the day's labors should be left at the office, or in the Navy aboard ship. There are some who further contend that professional subjects should for the most part be excluded from the wardroom, after the four-thirty boat has left the ship. To this view

I cannot subscribe entirely. Such discussions are most often productive of much benefit, regardless of where or when they are conducted. Naval officers are generally accused of being chronically addicted to talking shop. Truthfully they are not, to my belief, any more at fault than any other group of men following a common profession. People, men in particular, like to talk on subjects they are interested in, because they know most about those subjects. Hence, left to themselves, you might expect doctors to talk of medicine, politicians of politics, athletes of athletics, educators of education, and musicians of music. There are some naval officers, of course, who are continually harping on the Navy, because it is the only subject they are prepared to talk upon. This is without question a nuisance. Nothing is more annoying at dinner than to find spray valves, stable-zenith instruments, or what the admiral said when he got paint on his sleeve, all mixed up with the soup. However, this same failing may be observed amongst individual members of other professions as, for example, Californians. It is a matter of common understanding and etiquette that in mixed company, on the beach, conversation should be conducted on a plane common to all participants. By the same token a group of officers aboard ship have as a common plane the Navy and it is entirely natural and to be expected that their discussions will be dominated by the Navy or, if you insist, "shop."

Now to return to the young J.O. and his search for experience, with its relation to talking "shop." We have concluded that experience, of the scope and breadth desired, should consist primarily of one's own experiences, and secondly knowledge of the experiences of others. The first requisite requires no discussion as it is daily obtained in the discharge of routine tasks and duties. The second may be obtained in two ways. First, through written records such as information bulletins, court-martial orders, bureau and fleet circulars and other official publications. These reports dispense to the service at large the facts attending casualties, disasters, errors in judgment, etc., so that all may benefit by the mistakes and misfortunes of a few. Secondly, it may be obtained through conversation with one's associates. Here is the field where the "shop" talkers make their greatest contributions.

There is no more fruitful field for beneficial knowledge than is found in the mistakes of others. A great number of these mistakes or incidents will be found in the official publications previously mentioned. But a great number, because of their relatively minor importance, do not find their way into the official records. For these, unless we occupied ringside seats at the time of its occurrence, we must depend on the testimony of an "eye" or "hearsay" witness. It is here that the wardroom forum gets in its best work. The field covered by this convention in a single evening's endeavor beggars description. Let us visit awhile.

Draw up a chair as the toreadors unfurl their red capes and, lubricating their vocal organs with one or two shots of Java, burst into full cry. Lend an attentive ear and you will hear and learn of many things: what Bill Jones did when the turret caught on fire, and what "Red" Smith didn't do when his submarine expended a starboard "wheel" and his stern "skags" coming alongside something or other in San Francisco Bay; of "Pay" Carruthers who made Title "B" custodies a joy to all concerned, and how "Doc" Brown soothes the heebie-jebbies; of "Al" Anderson, student naval aviator, who made a dead-stick landing in the Bayou Saragossa; and of how Jim Green, judge advocate, utterly confounded the legal talent of the defense by a cagey display of legal dodges.

Then you will hear discussed the latest mooring boards; fire-control installations and problems; the latest misbehaviour of Mr. Sumner's lines; what chicanery was practiced to enable the U.S.S. *Strawbottom* to stand first in the destroyer engineering competition; why the British spotting system is all wet; what makes the *Lexington* and *Saratoga* faster than the old *Emma Giles;* and why light bombing planes should, by surface ships, be viewed with alarm.

In most cases, unless some master mind has the deck, for each theory advanced will be found some individual, or group of individuals, who will rise up and state, in no uncertain terms, that the advancers are full of oats. Then indeed will the flood gates of previous experience be thrown open and the battle rage with fury.

Finally you will be asked to shed a tear for Captain Brown who tried to take the U.S.S. *Ark* to Boston by the overland route

via Cape Cod; to remember Jack White who filed no complaint when his parachute failed to open; and to consider the case of "Bat" Smith who temporarily confused red and green. The tragedies of each will be thoroughly discussed and the various preventions and remedies paraded for your information and approval.

Sitting in as an active participant or as a silent observer, the seeker of experience will find his store of knowledge gradually increasing. Finding himself in similar jams and positions he will be armed with the experiences of those who have been there before him, and they are legion.

It will be advanced that as much misinformation as information can be carried away from these combats of the wardroom warriors. This is true, possibly, but if a member will exercise his membership as he goes from ship to ship, he will eventually run into someone who was there, or who knows better, and who will correct the misinformation.

I make no particular plea for the members of the China Station club, Constantinople sailors, or the Special Service boys. Their discussions have little to do with naval science and while you may gain useful knowledge and experience by attending their ravings, you will not gain any particular professional benefit. If you have no interest in dear old Stamboul, or who socked who in the Astor in Shanghai, or as to what went on in Kelly's last Washington's Birthday, you may always exercise your prerogative of retiring to your cave, and there pursuing your meditations undisturbed.

Criticism is constructive, in a good many cases, and so is discussion. So I hold that the wardroom group has its place in the sun even as the missionary who spreads the doctrine amongst the heathen. Unless you have something better to do, you will lose little by joining the circle and listening in on the subjects there on tap. Their stories are interesting, they are informal, and you will enjoy hearing most of them. Sooner or later you will find yourself with arms waving and hair on end ready to die for whatever you are howling about.

It has been advanced by some officers who have discussed this theory that it is applicable to tenders, small craft, and aviation, but not to any great extent true of the wardrooms of battleships. This may be true, but it is hard to believe that battleship people talk, amongst themselves, only of the pay bill and prohibition. Perhaps the closer association of people on smaller ships makes the discussion of greater interest to all, but even on a battle wagon you should be able to find a group of congenial souls who will either accept your verbal information or else tell you it is all wet.

This applies also to contact with officers of foreign navies. The British, in Hongkong, told our submarine people of a method of turning a boat in a short distance that defied all the rules on the subject. They did not know who originated it, or why it worked; they only knew that it did work. On trial our people also found that it worked. So now if you see our submarines in San Diego or elsewhere slipping around the sterns of ships in a most unorthodox manner, you are observing the fruits of a wardroom meeting, ably assisted by the excellent soda found in Hongkong.

So may experience be gained with the ears as well as the eyes, and so does the record of what has gone before pass down to those who follow after. Here is a spring where all seekers of experience would do well to linger and drink, even though the watch boy does turn in at midnight and the bridge players complain that you are making too much noise.

So I have made my plea, and I hope that in the future it may move some of the self-appointed judges and juries to descend from their benches and panels, and there in the dust of the arena contribute their share to the common cause.

The Size *and* Spacing *of* Units *in* Certain New Large-Scale High Explosive Depots

By COMMANDER G. L. SCHUYLER, *U. S. Navy*

AS a result of the disaster at the Naval Ammunition Depot at Lake Denmark, N. J., in July, 1926, improved storage is being arranged for large quantities of TNT at the Naval Ammunition Depot at Hawthorne, Nev., at the Navy Mine Depot at Yorktown, Va., and at the Naval Ammunition Depot at Oahu Island, Hawaii. Millions of dollars are to be spent, and these projects are probably more extensive than others yet undertaken anywhere to furnish permanent, and particularly safe, peace-time storage for large quantities of military high explosives which are on hand.

At all of these places one will find no pretentious storage buildings. Instead he will find the whole area covered with equidistant groups of small cement "igloos." Each of these igloos, of identical size, will be shaped like a semi-cylinder with its axis on the ground, with earth piled against its sides as a barricade so as nearly to conceal it from view. There will in each group be seven igloos, i.e., a central one with six others around it as on the corners of a hexagon.

If one is at all curious, one may wonder what line of reasoning led to the adoption of a layout so novel and so essentially different from anything previously built. And one will be quite right in guessing that the ideas evident in this construction were arrived at only after considerable study.

Let us start at the beginning and, assuming the whole area covered with equidistant storage units of identical capacities, first see, with each unit *entirely* safe from the next one, whether large or small units are the more economical of area.

The American Table of Distances shows for various quantities of explosives detonating in barricaded magazines, that *inhabited* buildings must be located at the following distances at least in order just to escape "severe structural damage":

AMOUNT OF EXPLOSIVE	DISTANCE = d
200,000 lbs	2,090 ft.
400,000 lbs.	2,530 ft.
600,000 lbs.	2,930 ft.
800,000 lbs.	3,240 ft.
1,000,000 lbs.	3,460 ft.

If spaced equidistantly, units of these sizes will (neglecting borders) each account for an area of $.86d^2$. So the "amount of explosive stored per square foot of ground occupied" would then be:

SIZE OF UNIT	LBS. OF EXPLOSIVE PER SQ. FT. OF AREA
200,000 lbs	.053
400,000 lbs	.072
600,000 lbs	.081
800,000 lbs	.088
1,000,000 lbs	.097

In such storage, which meets the practically ideal requirements of having each strong and well-protected unit as far from any other as an *inhabited building* needs to be, economy of ground would clearly indicate the desirability of having each unit of maximum possible capacity. Military considerations, however, would argue strongly against risking over 1,000,000 pounds in the loss of any one building. One-million-pound units would under these conditions, be spaced 3,460 feet apart.

In such ideally safe storage, however, (a) the ground occupied would be more than we would probably be able to afford and (b) the amount of explosive risked in any one unit would still be undesirably large, but (c) if we tried for military reasons to reduce this, there would (while keeping the same general scheme) be even poorer economy of ground.

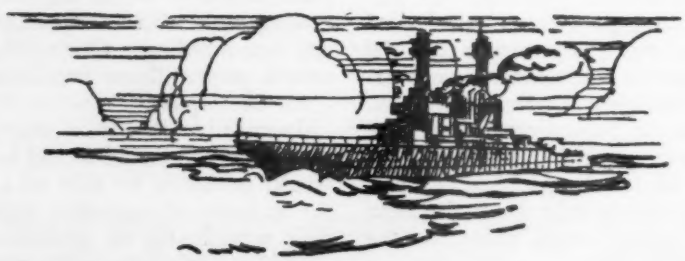
An escape from such difficulties however, led to splitting up each of these 1,000,000-pound units into a number of equal smaller ones sufficiently separated so that, though possibly they may somewhat damage one another, those of one group will at least not all go off simultaneously. With this arrangement, though a group itself would occupy more area than a single 1,000,000-pound unit, it may on reasonably sized areas still be possible to have *between groups* nearly the same ideally safe separation described above; since between the nearest buildings of adjacent groups we need then use only the much smaller safety distance indicated for *one* of these smaller units.

Seven small equal units seem a good number to have in each group, for then we can have a central one with the six others spaced equidistantly around it as on the corners of a hexagon. This would make each small unit hold 143,000 pounds of explosives. Five hundred feet as the spacing distance within such a group would be practically *twice* the spacing required by the New Jersey laws between barricaded magazines of this capacity, and would seem very conservative. Each group would occupy a circular area one thousand feet in diameter.

The American Table of Distances allows an inhabited building within 1,920 feet of a barricaded magazine containing 143,000 pounds of explosives, this being considered the distance at which it would just escape "severe structural damage." If we have groups of seven small buildings, each building containing 143,000 (or 1/7 of a million) pounds of explosives, the groups occupying circles 1,000 feet in diameter, with about 1,920 feet between nearest buildings of adjacent groups, the spacing from center to center of the groups would be 2,920 feet. This arrangement covers only 72 per cent of the ground called for by equidistant units of 1,000,000-pound capacity (or only 33 per cent of the ground called for by equidistant units of 143,000-pound capacity). It seems an improvement and it seems quite practicable.

With this layout, the size of each unit is kept down to 143,000 pounds, which does not appear to be an excessively large military risk. The loss of one unit may damage and it may possibly endanger magazines containing not over another 6/7 of a million pounds of explosives. Around the outside of each group which contains a total of 1,000,000 pounds, there will, however, be a space sufficiently wide to protect even inhabited buildings according to the American Table of Distances. The total area occupied by the same total amount of explosives is smaller, with similar protection, than would be possible between any practical sized units if they were spaced equidistantly. The layout as a whole would meet an unprecedented standard of safety.

It was for these reasons that such seven-unit groups were decided upon in this new construction, the relative locations of buildings described above being closely adhered to except where the contour of the terrain, etc., might indicate the desirability of making very minor modifications.



P. & A. Photo

VIEW OF THE LAKEHURST HANGAR

Showing its tremendous capacity. The airship on the right is the *Graf Zeppelin*, being housed after her 'round-the-world flight.

P. & A. Photo

THOUSANDS VIEWED THE DEDICATORY CEREMONIES AT AKRON, OHIO

When Rear Admiral William A. Moffett, U. S. Navy, drove the last rivet completing the master ring of the *ZRS-4* building at the works of the Goodyear-Zeppelin Corp.

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P. & A. Photo

THE *LOS ANGELES* SOARING OVER HANGAR AT AKRON, OHIO, DURING THE DEDICATORY CEREMONIES.

(See page 67)

International News Photos, Inc.

BRITISH DIRIGIBLE GIVEN STATIONARY TESTS

The British dirigible, *R-101,* moored to its mast at the Cardington Air Station after undergoing stationary tests which proved successful. A sister ship, the *R-100,* will be completed soon.

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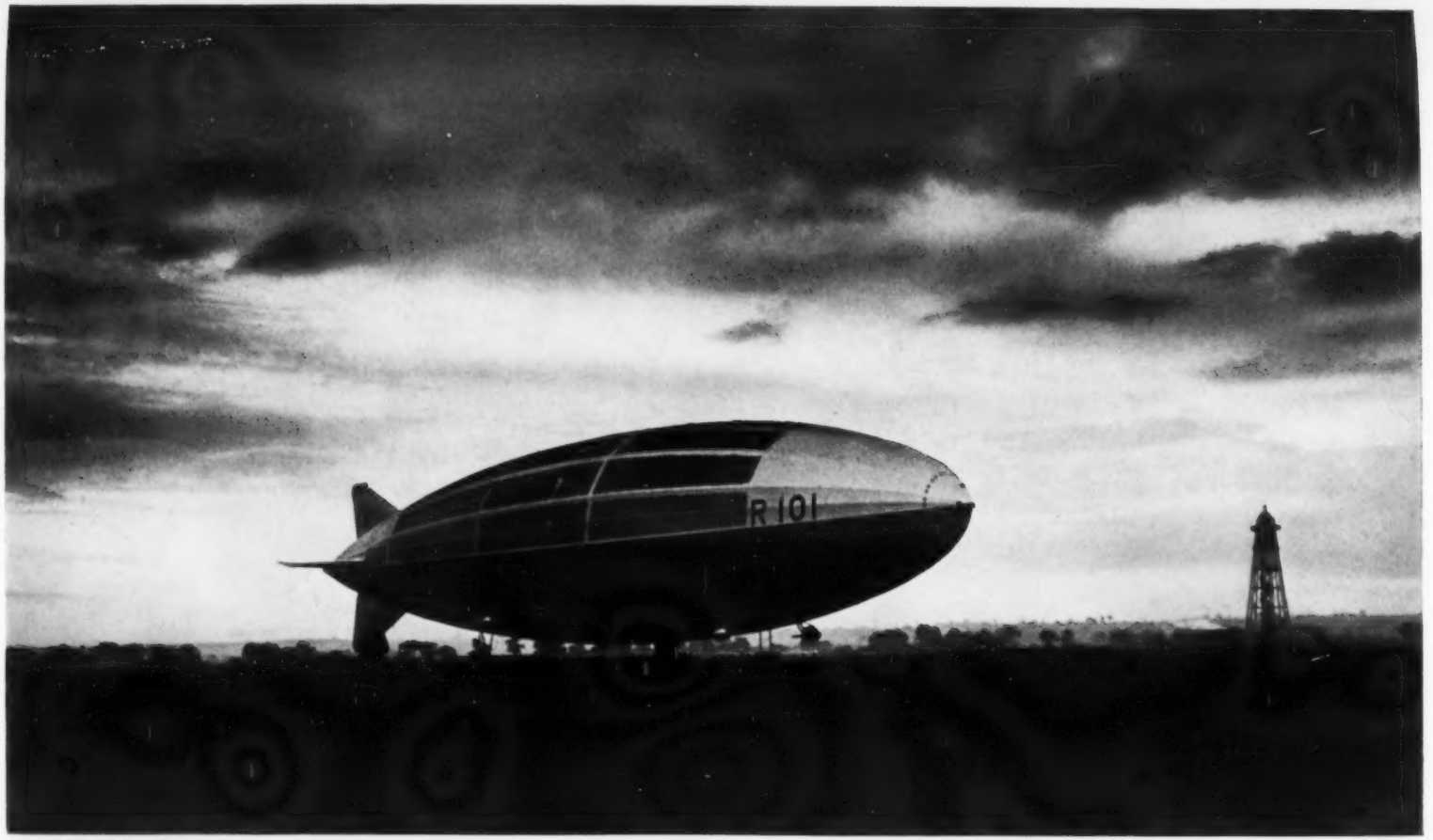

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THE *R-101* IN A TWILIGHT SETTING AT CARDINGTON AIR STATION

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GERMANY'S FIRST TAILLESS AIRPLANE

Great interest centered in the initial flight of this first tailless airplane to make its appearance in Germany. The elimination of practically the entire rear fuselage of the plane has been accomplished by placing a rudder at the tip of each wing and compressing the small 8-horsepower motor into the smallest possible space just at the rear of the pilot's seat. The result is an airplane which comprises little more than a cockpit and two wings.

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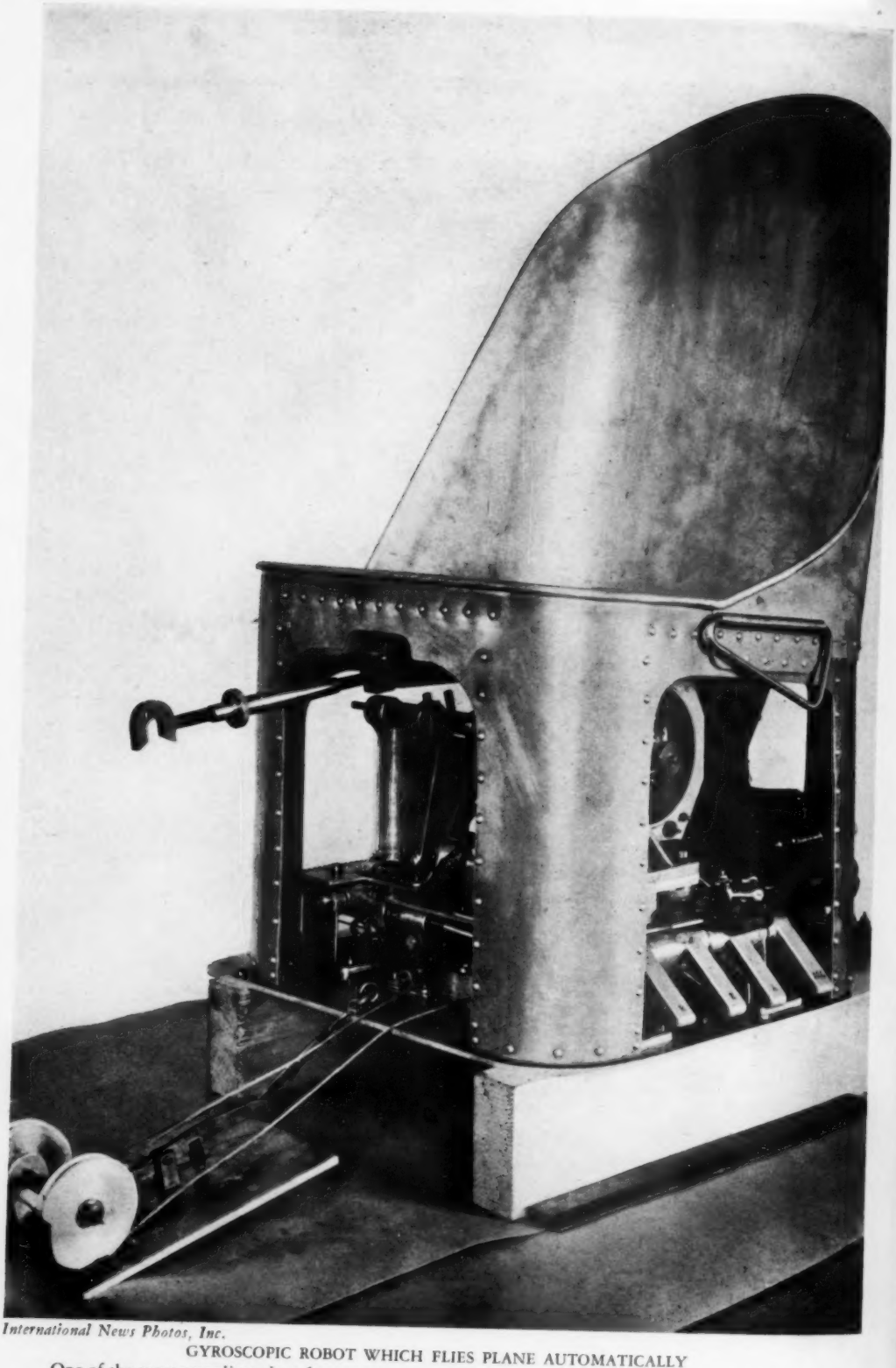
International News Photos, Inc.

THE FIRST FLIGHT OF GERMANY'S TAILLESS AIRPLANE

All Germany watched with deep interest this first flight of the new tailless airplane at Tempelhoff Field, near Berlin. Pilot Groenhoff is at the controls of the motor.

UNIV. OF MICH.



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GYROSCOPIC ROBOT WHICH FLIES PLANE AUTOMATICALLY

One of the most complicated performances ever achieved by man, flying an airplane under all conditions of weather and darkness, has been successfully accomplished by the use of this Sperry gyroscopic robot, which proved successful in several test flights over long distances. (See page 68.)

The Sperry device centers around two gyroscopes, one mounted horizontally and the other vertically. A series of electrical contacts actuates electro-magnets, which operate controls to the ailerons and rudder surfaces. The power is obtained from a small wind-driven generator mounted outside the fuselage. The robot weighs only 50 lbs. and occupies a space 14″ square and 10″ deep under the pilot's seat.

The Value *of* Engineering Competition

By Lieutenant Commander George K. Weber, *U. S. Navy*

As EACH fiscal year approaches the end, considerable interest is shown in the entire Navy as to the comparative standings of vessels in gunnery and engineering. As a consequence of this interest, there naturally comes a discussion as to the relative *value* or *harm* of this competition. Whether the methods used and rules promulgated are fair or not, it is a generally accepted fact that in all phases of life, competition and efficiency run hand in hand. This idea is embodied in the Rules for Engineering Competition, wherein it is stated: "The true objective of *competition* in engineering, whether on land or sea, is to obtain from the machinery installation the maximum *efficiency*, having due regard for the kind of service performed and consequent restrictions and regulations imposed by the nature of that service."

For the purpose of illustrating the definite and specific results obtainable by a consistent attempt to carry out the idea of real competition, which is the progressive improvement of the standard of operation of a particular unit, use is made of the data available from the engineering record of the U. S. S. *Oklahoma*. No comparison is made with other vessels.

Coincident with the winning of the White "E" for excellence in engineering in 1924-1925, the U. S. S. *Oklahoma* received a rather drastic, although natural, reduction in fuel allowance. The immediate effect of this cut in fuel allowance was that the *Oklahoma* was "finished" as far as further competition for engineering honors with other vessels was concerned. This feeling permeated to such an extent that it was discovered that the engineering plant, instead of improving, was actually becoming less efficient. That is to say, in addition to a lower comparative score with respect to other vessels, more fuel was being used than under similar steaming conditions the year before. This feeling of "We're finished" is the reason for several ships winning engineering prizes one year and being looked on as wrecks the next year. As interest is lost in the score, the score goes down. Then bad machinery condition is not so noticeable. So the score goes down still further and efficiency is no more. Similar conditions on the *Oklahoma* quickly showed deterioration. So a new and double system of record of operation was started—a record of scores based on the new allowance as required; but, also, and more important, a record of actual results of improvement as compared with the results obtained in previous years. The result was that, instead of going down with the "We're finished" flag flying, the plant actually improved with such startling results that it was thought they might be of interest to the service in general. The actual figures are shown in the table on the following page.

To eliminate the idea that these figures are just *statistics*, the engineering record of the *Oklahoma* shows that during the latter months of the year, just before the vessel went into the navy yard for modernization, the oil consumption was 70 gallons per mile and 112 gallons per hour, as compared with 123.8 gallons per mile and 211.8 gallons of fuel oil per hour. So that in spite of the expected deterioration with age, the engineering plant operations gave promise of a still greater saving of fuel possible in future operations.

That this improvement of an engineering plant and consequent immense saving of oil has a decided value is shown by a consideration of the effect on the following phases of naval life:

(a) The military value is apparent when it is realized that the cruising radius of the vessel has been increased over 30 per cent. The period of training or activity of the vessel with the fleet is increased so that in three years only 73 days are spent in a navy yard, as compared to 219 days for the previous three years. The mileage during

1	2	3	4	5	6	7
Eng. Year	*Miles steamed*	*Fuel used under way*	*Fuel per mile*	*Hours not under way*	*Fuel used not under way*	*Fuel per hour*
1923–1924	11,646.6	1,440,762	123.8	5,357.8	1,134,338	211.8
1924–1925	19,467.9	1,948,949	100.2	6,308.1	1,048,526	165.8
1925–1926	34,554.8	3,434,733	99.4	4,466.0	662,587	148.1
1926–1927	22,654.5	1,930,478	85.2	6,072.1	753,729	124.1

Under way		*Not under way*		
8	9	10	11	12
Fuel nec. under 1923–24 std. of operation (Col. 2×123.8)	*Fuel saved* (Col. 8–Col. 3)	*Fuel nec. under 1923–24 std. of operations* (Col. 5×211.8)	*Fuel saved* (Col. 10–Col. 6)	*Total fuel saved for year under improved std.*
1,440,762	0	1,134,338	0	0
2,410,126	461,177	1,536,056	287,530	748,707
2,477,884	843,151	945,899	283,312	1,126,463
2,804,627	874,149	1,286,070	532,341	1,406,490
			Total	3,281,660

Eng. Year	*Miles Steamed*	*Days at Navy Yard*
1921–1922	18,715	42
1922–1923	16,439	89
1923–1924	11,646	88
Total	46,800	219
1924–1925	19,467	0
1925–1926	34,554	51
1926–1927	22,654	22
Total	76,675	73

the period of improvement was 76,675 miles, as compared to 46,800 miles in the previous three years. This bears on the point that a superior armament is of no value unless you have the engineering plant to get the vessel into position and keep it there. More reliability of ships in time of war is assured as a result of engineering competition. Given a definite amount of fuel allowed for the whole fleet, the greater the competition and incidental saving of fuel that is accomplished, the greater is the amount of cruising and training for the fleet.

The training of engineers incidental to a strict observance of the rules and spirit of the engineering competition ensures analysis of all engineering problems and suggestions for improvements on new design, so that the U. S. Navy may always have the finest engineering installations possible and the engineers capable of running these installations economically.

(b) The economical or financial value of competition is immediately apparent from the fact that a saving of 3,281,660 gallons of oil represents the fuel bill of a full average year of steaming for a battleship at an estimated cost of $80,000. The larger and possibly greater financial factor is the saving effected in regard to navy yard overhaul. Any officer who has been through the experience of having a considerable portion of his important navy yard requests turned down on "account of lack of funds" must realize what a potential help comes from a vessel that is able to cut her time in the navy yard in half through competitive methods. Commercial concerns anticipate depreciation of power plants, but all large corporations work on a competitive basis, with installations and engineers being juggled around as a direct effect of results obtained. This competition is justified by the immense saving effected by keeping their power plants in

the best possible condition. And so in the Navy an immense saving in material and replacements is effected by the incidental high standard set by competition.

(c) The moral value of competition is of an indefinite nature, as this subject gives rise to most discussion. It is rather difficult to conceive that the education and training of personnel incident to competition can have other than a highly beneficial effect. The enthusiasm of a unit that is on the job and out to win is so contagious that even those who by natural inclination would take no part in competition are dragged along. The result is that a generally higher standard of personnel is developed with the improvement in mechanical efficiency.

(d) The advertising or propaganda value of competition cannot be overlooked, as it is the general public to which the Navy must look for support. The man who pays the taxes must be made to know that he is getting his dollar's worth of insurance and security. The concerns that try to sell their goods to the Navy realize this, as they are all on a competitive basis and "none but the best will do." So there can be no better advertisement of the Navy than the man who goes out after several years in the service during which time he has been one of the factors in competition. He tells the world how they saved fuel and material in the Navy. The man may do this in ordinary conversation or in the idea of getting a job. It is the author's experience that a great many men have referred to their records in engineering as their best bet in getting a job on the outside. At this point, it seems well to mention a plan that the author followed as a result of numerous requests for endorsements or recommendations for men who had served under him and who were now applying for a civilian job. In answering these requests from concerns for endorsements, a notation was always put on the bottom requesting that the author be informed after a definite period as to the man's suitability and worthiness from the civilian company's standpoint. This is thought to give the endorsement more value, as it shows an honest desire to give conscientious endorsements. The response has been very good. This plan is also known to the men before they leave the ship, so that they are under a double charge to continue making good.

In conclusion, it is thought that these facts presented have a definite bearing on the most common criticism of the Rules for Engineering Competition. In that no comparison is made with any other vessel and no reference is made to the bugaboo "allowance of fuel," it may be that some scheme could be proposed whereby a ship would be assigned a competitive factor based absolutely on actual results and entirely eliminate the seemingly unsatisfactory "fuel allowance" problem.

It stands to reason that a ship should be marked on her potential value in regard to saving in actual fuel consumption and reliability, which counts in peace training as well as in war, instead of on a rather ephemeral curve of fuel allowances, which has been the apparent cause of a ship's steaming well one year and being looked on as a wreck the next year. It is in the actual saving of fuel and improvement of reliability that the real value of engineering competition lies.

The Battleship

By COMMANDER CHARLES S. STANWORTH, *U. S. Navy (Retired)*

THE distinctive feature that marks the battleship is the supposed ability to receive as well as give hard knocks, or in other words, defensive armor of such thickness and so arranged as to keep out the shells of an enemy. The question of whether the battleship is merely the survival of an idea, and is no longer a utility, has been confused by the consideration of new weapons of offense, the torpedo, the mine, the airplane bomb; but we may dismiss these weapons from consideration and consider the gun only.

In the eighties and nineties, the main topic of naval discussion was the struggle between the armor and the gun. We had compound armor, then Harveyized and Krupp armor; the steel shell, then the capped shell. But after the introduction of a new powder that was a chemical compound instead of a mechanical mixture, the armor versus gun discussion faded away, leaving the gun victor. That the victory was complete is shown in the increase of battle ranges from ten to twenty-five thousand yards.

Conservatism is natural in any permanent organization, and is fostered by selection, which discourages methods and thoughts that are alien to the methods and thoughts of the older and hence more conservative officers.

The Navy adopted with resistance the Fiske telescopic sight, the Sims method of target practice, Poundstone's suggestion of the all-big-gun ship, and it clung until recently to the ram bow.

At the battle of Lissa, the Austrian attack was bold, the Italian gunfire was inefficient, and though several attempts were made, only one Austrian ship successfully rammed an Italian. Yet from that inconclusive data ram bows were installed on cruisers and battleships, and were given up long after the destructive effect of gunfire made it impossible for a ship to ram, as well as inexpedient, for ships could be sunk by gunfire without risk to the hull of your ship by ramming.

For a long period we equipped cruisers and battleships with torpedoes, and only escaped the torpedo-net equipment because we had no battleships at the time that torpedo nets were considered necessary.

Although the increased accuracy and destructive effect of gunfire, and the increased battle ranges, finally led to the abandonment of ram bows and torpedo tubes on battleships, we have never logically considered the effect of these factors on armor. Perhaps it is because of a deeply rooted instinct such as is expressed in the saying that a drowning man will clutch at a straw.

As long as battle ranges were short enough to allow a flat trajectory, a side armor belt nine to fourteen feet wide and turret protection were considered sufficient to keep out direct hits, but with the new battle ranges, flat trajectories are no longer possible, and the angle of descent of the projectile exposes the decks of battleships to a direct hit. But an increase in the thickness of the armored deck involves widths of ninety feet instead of fourteen feet, and we are forced to increase the percentage of displacement weights allotted to armor.

In the assignment of displacement weights, about 50 per cent was allotted to passive defense, and armor protection was the most expensive of construction costs. The outer skin of a vessel is an area of the second degree, whereas the cubical contents are of the third degree, so in order to secure displacement for guns, ammunition, engines, and fuel, the size of battleships was constantly increased, which involved extra costs in harbor depths and dry docks. This simple remedy is no longer available with a limited displacement, and we have come to an *impasse*.

Increase in battle ranges makes necessary increase in thickness of protective deck, and

an increase in the percentage allowed for protection.

If we accept this, and our ships have protection at great ranges, and the enemy has not, we naturally select great ranges in action. But to select our ranges means we must have superior speed, and hence must allow a greater percentage of weight to engines.

To insure destructive effect at great ranges our guns must be of great caliber and weight.

Since accuracy of gunfire decreases with great ranges and a curved trajectory, we must increase the weights allotted to ammunition.

As we lack naval bases, our weights allotted to fuel cannot be decreased.

With a fixed displacement, I defy American ingenuity to solve this problem, unless like Columbus with the egg, we cut off something, and we must free ourselves of this fetish "armor."

In 1915 I wrote Admiral Plunkett, then inspector of target practice, advocating smaller battleship units, no armor, great maneuvering qualities, and the adoption of "dodging" the enemy shell, but the reply was that changes of course disturbed the aim of our guns, although I understand that the fleet has since adopted this principle.

Removing armor and gun turrets lessens weights in the hull framing, and allows unlimited angles of gun elevation, gyroscopic gun platforms, and increased length of guns.

The battleship is spoken of as the "backbone of the fleet," but what vertebrate animal uses its backbone for offense or defense?

The simile is apt, however, if we consider the formation of the Grand Fleet with the husky dogs of war in the rear, protected by a screen of scouts, torpedo-boat destroyers, submarines, and airplanes.

And if contact is made with the enemy fleet, the airplanes and submarines remain at the front to win command of the air and underwater, then push through to attack the enemy battleships, before our battleships advance.

What quirk of mind is it that dwells on safety for the personnel of the battleship, but pays no attention to the personnel of the cruisers, destroyers, submarines, and airplanes.

Lieutenant Percival in the August PROCEEDINGS emphasizes as important, protecting with armor the crews of rapid-fire guns, because they may be attacked by airplanes, vulnerable to rifle fire.

Battle at sea cannot be made safe, nor is morale improved by seeking shelter. The Great War was at a stalemate because of shelter in trenches, and the war was not won by armored tanks, but by the resumption of open fighting by the infantry after a preliminary barrage of artillery fire.

The Researches *of* Professor A. A. Michelson

By Professor William H. Crew

A FEW years ago when the Naval Institute established the policy of publishing each month a photograph of a distinguished graduate of the U. S. Naval Academy in civil life, the series was headed by a picture of Professor A. A. Michelson of the class of 1873. Because of Professor Michelson's remarkable career and singular achievements, which have contributed in no small way toward inspiring a new trend of thought in the realm of modern physics, it is perhaps not out of order to augment the recognition already rendered our distinguished fellow alumnus by a somewhat more detailed account of his professional career.

In a recent issue of the New York *Times*[1] an item is headlined "Michelson, at Seventy-six, Outlines Three New Tasks." From this, one may conclude, and rightly, that at present Professor Michelson is actively engaged in his researches; and accordingly, it would be folly were I to endeavor here to appraise his contributions or extol his works at a time when they are still in the process of being refined and perfected.

It is my purpose merely to sketch briefly the scientific achievements of the man whose first researches were carried out at the U. S. Naval Academy over fifty years ago and who now, at the age of seventy-six, has set for himself three tasks which to others, even in his own field, seem almost Herculean. And furthermore, it will be interesting to note the far-reaching significance and influence on contemporary thought in physics that may be attributed to these major researches of Professor Michelson.

More than three-quarters of a century have passed since Albert Abraham Michelson was born in a small village, Strelno, just forty miles from the birthplace of Copernicus and then, 1852, a part of Germany, but now within the borders of Poland. But during practically all of that time he has lived in America as a citizen of the United States.

[1] 18 Jan., 1929.

At the age of sixteen he was appointed by President Grant as a midshipman at the U. S. Naval Academy and was graduated four years later in the class of 1873, or as then designated, "Date of '69." One reads with interest Admiral Fiske's account[2] of his boxing tilt with Michelson when they were schoolmates at the Naval Academy, a fight from which Fiske emerged in rather the worse condition. However, upon the admiral's own admission, his admiration of Michelson the "pugilist" is surpassed by his admiration of Michelson the physicist. We also learn from Admiral Fiske that an innate interest in physical experiment and evidence of unusual ingenuity were observed in Michelson during his years as midshipman; although Admiral Worden,[3] so it is alleged, was a bit concerned for the future of one who devoted so much of his time to extra-curricular experiments. Humanity may be thankful for the influence that then permitted the individual to follow his true bent undeviated by the rigid restraints of a military régime.

Not very long after graduating Michelson was detailed to the Naval Academy (1875-1879) as an instructor in mathematics and physics, and at that time he outlined in a simple, characteristic half page in *Nature*[4] an improved method of determining the velocity of light.

Before the Navy had established a post-graduate school, certain officers were selected and sent abroad for graduate study, and in this line of duty Michelson spent the years 1880 to 1882 in Berlin, Heidelberg, and Paris; and in the following year he resigned from the Navy to enter upon an academic career. It is interesting to note that

[2] Fiske, *From Midshipman to Rear Admiral*, p. 15.

[3] Admiral Worden was then superintendent of the Academy, and formerly commanding officer of the ironclad *Monitor*.

[4] *Nature*, **18**, 195 (1878).

thirty-six years later (1918) he was again on the Navy Register, enrolled in the U. S. Naval Reserve Force as a specialist. I recall with pleasure making a visit during the War to the roof of his laboratory at the University of Chicago where he was developing an optical range finder for use by Navy vessels.

Following his early Navy career, Michelson became a professor of physics first at the Case School of Applied Science at Cleveland and later at Clark University at Worcester and finally, since 1892, at the University of Chicago, to which he was called as head of the Department of Physics.

The recognition of Professor Michelson as a scholar and an investigator of the highest order is borne out by the many honors, both foreign and domestic, of which he has been the recipient. His awards, such as the Rumford Medal, the Copley Medal, etc., are too numerous to mention here, but one cannot resist pointing particularly to the fact that Professor Michelson was the first American physicist to receive the Nobel Prize Award.

Although for nearly forty years Professor Michelson has made his home in Chicago, much of his time has been recently spent in California where, even during the last summer, he has been repeating the ether-drift and velocity-of-light experiments, always with new and improved technique, increased precision, and with convincing results. It is thus that we learn of "Michelson, at Seventy-six, Outlines Three New Tasks" which are in brief: the redetermination of the velocity of light; a refinement of the measurement of the diameters of stars; and another search for a possible ether-drift.

It may be of interest now to review very briefly the principle researches of Professor Michelson; and then to consider their bearing and influence on current physical thought.

Probably the first serious effort to find out whether or not the velocity of light is finite was made by Galileo; but the crudeness of his experiments left him with no evidence that the passage of light from one point to another was not instantaneous. In 1676 the Danish astronomer, Römer, pointed out that inequalities of the time intervals between eclipses of Jupiter by one of its satellites may be accounted for by the varying distance of the earth from that planet due to the periodic motion of the earth about the sun and at the same time assuming a finite velocity of light of about 192,000 miles per second. Subsequently, short-range determinations of this velocity were made, and noteworthy were the toothed-wheel experiments of Fizeau (1849) and Cornu (1874), and at the same time the revolving-mirror experiment of Foucault.

The method of determination of the velocity of light as proposed by Michelson[4] in 1878 was that of the revolving mirror, driven by an air blast and calibrated against a tuning fork of accurately known frequency. The apparatus for this experiment was set up along the sea wall of the Naval Academy at Annapolis, a position which is now occupied by the tennis courts. Here an unobstructed path of five hundred feet between mirrors was obtainable. The results of this experiment were published in the *Proceedings of the American Association for Advancement of Science*[5] in 1878, and the best value obtained, 186,508 miles per second, was a mean of ten independent observations "made under difficulties, and with apparatus adapted from material found in the laboratory of the Naval School."

In the years subsequent to 1878 improvements in the measurements of the two fundamental factors in this experiment, the *distance* interval and the *time* interval of the passage of the light beam, have been made under the direction of Professor Michelson. The distance between mirrors in the 1924 determination[6] was about twenty-two miles, accurately measured for the purpose by the U. S. Coast and Geodetic Survey, between Mount Wilson and Mount San Antonio in California. The rotating mirror in this case was in the form of an octagonal prism, each face being an optical flat, and it functioned also as a timer by virtue of its calibration with a standardized tuning fork. This experiment has given what is by all odds the most trustworthy value of the velocity of light, namely, 186,359 miles per second in air.

In the early eighties, when in Germany, Professor Michelson's interests were first directed to the "Aberration Question," which

[5] This article has recently been republished in the *Scientific Monthly* for December, 1928.

[6] Michelson, *Astrophysical Journal* **60**, 260 (1924).

in short was this: "Does the medium, usually called 'ether,' in which light waves are propagated through empty space, remain fixed with respect to the stellar universe while the earth moves freely through it; or does the earth drag the ether with it, as a rapidly moving vehicle carries a quantity of air with it into its motion?"

A study of this question, both experimental and theoretical, has led the way to a vastly greater comprehension of the universe in which we live than has, perhaps, ever been realized before. In particular, the results of the now famous "Michelson and Morley Ether-Drift Experiment," carried out at Cleveland in 1887, gave the initial impetus to the theory of relativity. Let us pause for a moment to consider this far-reaching experiment.

As early as 1880, Professor Michelson conceived the idea of making a direct test for ether-drift by sending simultaneously two beams of light waves out from a point in two mutually perpendicular directions, and by means of mirrors reflecting each back along its own path to the starting point. If, during such an experiment, there is no drift of the ether, the two beams of light waves will arrive together in step; but, on the other hand, if there is a drift of the ether along the path of one of the light beams, then the two sets of waves will arrive somewhat out of step. To measure such a possible "out-of-stepness" Michelson invented (1882) a simple but tremendously ingenious interferometer, an instrument which has since found application in many and various types of optical measurements.

His first effort to detect ether-drift with an interferometer was in Helmholtz' laboratory in Berlin; but here the vibrations due to city traffic made the use of this instrument impossible, and accordingly the apparatus was moved to Potsdam. The results obtained there, however, were considered inaccurate and therefore of no significance.

Upon returning to America, Professor Michelson, assisted by Professor Morley, built an interferometer on a large scale at the Case School of Applied Science; and there they made the surprising observation that the light waves reflected back along the two perpendicular paths of the interferometer met one another "in step." The immediate interpretation of this was that there was *no relative motion,* that is, no drift, between the earth and the ether. This experimental observation was repeated later, and with increased precision, by Morley and Miller at Cleveland, and by Michelson at the University of Chicago, and in each instance the original Michelson-Morley experiment was substantiated.

This experimental result which indicated no ether-drift was in contradiction to the supposed facts deduced from observations of aberration; and as late as 1900 Lord Kelvin, at the International Congress of Physics held in Paris, averred that the "only cloud in the clear sky of the theory of the ether was the null result of the Michelson-Morley experiment." But at about that time Lorentz, in Holland, and Fitzgerald, in Ireland, proposed an hypothesis to make compatible the results of the Michelson-Morley experiment and the earlier aberration experiments; and it was this hypothesis, now usually referred to as the Lorentz-Fitzgerald contraction hypothesis, on which Einstein founded his theory of relativity in 1905. The influences of this theory are too numerous and too profound to mention here, but suffice it to say that they have introduced entirely new and extremely interesting speculations as to the structure of atoms and in general the nature of things.

In the years 1921 to 1925 very extensive ether-drift experiments were carried out by Professor Miller at the Mount Wilson Observatory in California. Physicists the world over were astounded when Professor Miller announced an observed motion of the ether of about ten kilometers per second; for such a result was apparently in disagreement with the Michelson-Morley experiment and with the theory of relativity. Professor Miller then carefully repeated the experiment and verified this former result, but the same experiment was done independently at Mount Wilson by Dr. Roy Kennedy, who found no evidence of an ether-drift. A few years later Professor Michelson went to California and there repeated his ether-drift experiment, and in November of 1928 at Washington he announced to a very eager and attentive audience at a meeting of the Optical Society of America the result of this last and most precise experiment—no observable ether-drift. The contrary results of Professor Miller's experiments, done under his keen supervision and

skillful hand, still stand unexplained; but the situation, as recognized by the scientific world, is that relativity remains vindicated.

In conclusion I wish to speak briefly of some of the other important achievements of Professor Michelson. I have mentioned the interferometer which was devised by him for the purpose of determining a possible ether-drift. This same instrument has found most remarkable applications in other fields of science, notably in the measurement of the distance between components of double stars or in the measurement of the diameter of the giant star Betelgeuse. In this latter instance an interferometer was mounted on the end of the 100-inch reflecting telescope at the Mount Wilson Observatory; and the diameter of this great star, located in the constellation of Orion, was calculated to be 240 million miles, a distance about equal to the diameter of the orbit of Mars.

The international standard of length is the distance between two scratches on a particular bar of platinum-iridium kept at Sèvres near Paris, and is known as the standard meter. In order to establish permanently this standard of length so that it might never be lost to mankind due to material destruction, Professor Michelson spent the first year of his appointment at the University of Chicago in Paris in determining this length in terms of the wave length of a particular red line in the spectrum of cadmium. For this purpose again the interferometer was brought into use and a most accurate determination yielded the result that one meter is equivalent to 1,553,163.5 wave lengths of this particular red cadmium line. And now we may rest assured that even though the standard meter of Paris be destroyed by war, by vandalism, or by natural causes, it could be again reproduced to within an accuracy of at least one part in three million. It is a remarkable thing and a fortunate one that the wave lengths of any element such as cadmium are identical the world over and probably throughout the entire universe.

From this brief résumé of Professor Michelson's achievements it may be concluded that their distinguishing feature is precision. The economic value of these experiments of precision cannot be estimated in numbers but their use in promoting useful and properly directed thought is inestimable, and an interesting discussion of these uses has recently been given by Professor Millikan in *Science* for May 10, 1929. Certainly of greatest importance, in my mind, is the ether-drift experiment which triggered off the study of relativity, which in turn has promoted thought along the lines of atomic structure, has introduced the notion that energy is intimately related to mass, and has finally led to exceedingly interesting speculations as to the constitution of stars. Knowledge along this line certainly seems worth while in that possibly our future source of energy may be the stars, or, in particular, the sun.

As the Copernican theory led mankind away from geocentric ideas, so has the theory of relativity led him away from egocentric ideas, that is to say, one can no longer honestly estimate velocities and accelerations with respect to himself but must also extend to other stars and even other universes the privilege of being the basis of reference. A most entertaining and illuminating discussion of this subject is to be found in Eddington's recent book, *The Nature of the Physical World*.

To conclude this description of Professor Michelson's researches without mention of those which distinguish him as an artist as well as a scientist would be an unfortunate omission. Professor Michelson claims to have first learned to sketch at the Naval Academy, and later practiced a bit in oils and water colors. In recent years, however, he has spent his efforts only in water colors and in January of 1928 an exhibition of some of his work, or shall we not say pleasure, was sponsored by the Renaissance Society of Chicago.

These valuable scientific researches in themselves stand as evidence to the skill and mental prowess of Professor A. A. Michelson as an investigator, and the U. S. Naval Academy may well be proud to count him as one of its graduates; but these researches are apparently not the last, and the results of the three tasks which Professor Michelson, at the age of seventy-six, has set for himself, are awaited with genuine interest by the world at large.

Postgraduate School, U.S. Naval Academy, Annapolis, Md., Sept. 1, 1929

The Velocity *of* Light

By Associate Professor Earl W. Thomson, *U.S.N.A.*

FIFTY years ago in the summer of 1879 a young instructor in the Department of Physics and Chemistry at the Naval Academy read a report before the Saratoga meeting of the American Association for the Advancement of Science on the "Experimental Determination of the Velocity of Light." This instructor, who then held the rank of master, U. S. Navy, was Albert A. Michelson who in the succeeding half century has made a niche for himself through his brilliant researches as the dean of American physicists.

During the same year Thomas A. Edison in his laboratory at Menlo Park, New Jersey, perfected the first electric light globe, the golden jubliee of which has recently been held throughout the world. The one research was in the realm of pure science, the other in the field of invention. Which of these solutions of important problems was of the more value need not be discussed, as one has revolutionized modern living and the other has changed the trend of modern scientific thought.

Why should the speed of light be an important constant? Why should it be necessary to measure it to any great accuracy? The entire answers to these questions were not known in 1879, but the following years have shown that Michelson's first research along this line was even more important than was then thought. The speed of light is the measuring stick that is used in dealing with the enormous distances that the astronomers measure, the billions of miles to the distant stars and nebulæ, and this measuring rod should be as accurate as that "distance between two parallel marks on a platinum-iridium bar kept in the archives of the International Bureau of Weights and Measures at Sèvres"—the standard meter. And now in later years with Einstein and his interpretation of the Michelson-Morley experiment, the speed of light assumes a new significance, as he postulates that this speed is the only physical entity which is absolutely constant in the universe, being independent of the motion of the vibrating system which created the light. The length, the mass, and the energy of a moving system is assumed to change with the motion, but the speed of light remains the same, constant and unchangeable. Also the speed of light is the maximum of all speed—absolute, supreme, —the asymptote that others may approach in value, but neither equal nor surpass.

With the study in later years of Maxwell and his electromagnetic vibrations through the postulated ether we have found that visible light is merely one of a family of waves whose sizes vary from that of the infinitesimal cosmic rays, reported on during the past year by Professor Millikan, to the longest of what were originally known as Hertzian rays—our modern radio waves—transmitted by the highest powered transatlantic stations. In this electromagnetic spectrum all of the rays, no matter what their source or what their effect, have the same velocity through the ether or interplanetary space. This speed is that of the visible waves—light. In this family we have the aforementioned cosmic rays, X-rays, ultra-violet, infra-red, radio waves, and many others between these, not so well known, but maybe some day to be of paramount importance. The only common family characteristic that all of these have, except that they are the combination of a variation in an electrical and a magnetic field, is that they travel with the same speed. Hence the speed of light is also the speed of radio, of ultra-violet, or of X-rays.

We may suppose that the ancients, as they watched the stars in the heavens and the flashes of the powerful lightning, believed that the speed of light was infinite, and that the light traveled instantaneously. Galileo is given credit for the first scientific experiment to determine this speed, but his apparatus was crude and his results were

negative. Even though Galileo may be regarded as the greatest exposer of philosophical fallacies of all time, and the one man who started the science of physics on an accurate experimental basis, yet the speed of light was too great for the apparatus of the laboratory of the early seventeenth century.

As velocity is the ratio of distance and time, for such a stupendous speed we must have either an enormous distance as in astronomy, or else have an accurate way of measuring extremely small intervals of time, as small as a millionth of a second. These requirements are the basis of the division of the four methods for the determination of this constant into the astronomical, as illustrated by the methods of Römer and Bradley, and the terrestrial or laboratory methods as used by Fizeau and Foucault.

Römer's Method

Galileo, with the help of the negative telescope which he introduced to the savants of the age, had discovered in 1610 the satellites of Jupiter. During the next century observatories and telescopes were built and the astronomers of the time made many measurements on these moons, their periodicity, which varied from forty-two hours to sixteen days, and their eclipses. Ole Römer, a Danish astronomer, when occupied at the Royal Observatory at Paris in 1675, noticed that there was an anomaly in the periods of the eclipses of the same satellite. When the earth was approaching Jupiter the interval between successive eclipses was shorter, and when the earth was receding from Jupiter the period was longer. He gave this observation what we now know is the correct interpretation—that the light has a finite velocity. As the earth approached, the distance, and therefore the time, was shortened, and when going away the distance of travel of the light and therefore the time was lengthened. Römer discovered that the light took eighteen minutes to cross the diameter of the earth's orbit, 186,000,000 miles in 1,000 seconds. But Römer did not arrive at the correct value of the velocity, because in order to secure this it was necessary to know the parallax of the sun, that is the angle subtended by the earth's radius at the sun, and the distance of the sun from the earth, and at that time neither of these was known with any degree of accuracy. But to Römer must go the credit of stating that the velocity of light was finite and that it could be determined. His method is now used rather for determining the sun's parallax and distance rather than the speed of light, this latter having been determined more accurately by other methods.

The French astronomer Jean Baptiste Delambre, from a computational study of the satellites of Jupiter in 1792, gave the speed of light as 193,350 miles per second.

Bradley's Aberration Method

The second of the astronomical methods is based upon the phenomenon of the aberration of the stars, that is that any star describes annually an elliptical orbit such that at any time it is apparently displaced from its true position. Dr. James Bradley, the astronomer royal of England, made this discovery at Kew in 1725 when he observed that γ *Draconis* in March was in a position twenty seconds more southerly than in December (see Fig. I) and then that it proceeded northwards until in September it was forty seconds more northerly than in March The explanation, which we now know illustrates the difference between apparent and relative motion, a problem in vector differences, came to Dr. Bradley while sailing on the Thames. As his boat changed its course the vane on the boat also changed. If the speed of the ship were *AE*, Fig. II, and the true speed of the wind were *BA*, then the apparent speed of the wind is the vector sum of *AB* and *DB* (the negative of *AE*), and the wind has apparently shifted

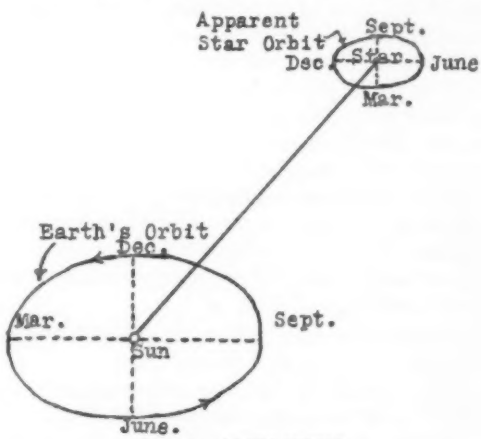

FIG. I. ABERRATION

Apparent displacement of star is in direction of motion of earth at that time.

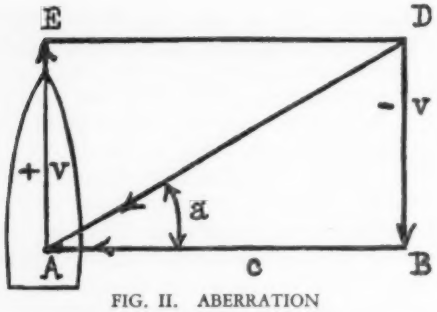

FIG. II. ABERRATION

due to the speed of the boat by an angle *a* in the direction of motion of the boat, such that *tan a=AE/BA*.

Transferring this analogy to that of the aberration, Bradley concluded that the telescope was shifted a maximum of twenty seconds away from the true star position in the direction of motion of the earth due to the compounding of the speed of the earth and the speed of light. If we know the linear speed of the earth in its orbit and the "constant of aberration," the speed of light is readily calculated. With the value of 20″.445 Struve calculated the velocity of light as 191,513 miles per second, a value several per cent too high due to an error in the assumption of the distance from the earth to the sun.

Both of the astronomical methods depend for their accuracy upon knowing the exact values of the astronomical constants. In recent years the following values have been computed:

Constant of aberration=20″.4962±0″.006

Time taken by light to traverse the mean radius of the earth's orbit=498″.82±0″.1

Mean distance from earth to sun=92,900,000 miles

Velocity of light=186,330 miles per second

Velocity of light=299,870±30 kilometers per second

FIZEAU'S METHOD

Over a century went by before the first terrestrial method of determining the velocity of light was successfully made in Paris by Armand Fizeau, a French physicist. The method may be thought of as a variation of that of Galileo, of successively shutting off and exposing a beam of light, and measuring the time of travel over a known distance. In 1849 Fizeau had constructed a disk with 720 teeth and slots of equal size, the disk being rotated at a constant speed by a train of wheels and weights.

A beam of light from the source *L* is brought to a focus at the slot *S* of the toothed disk *D* by means of a lens and mirror (see Fig. III). The light is then made parallel by a lens *O* and travels over a long distance to another lens *O′* and is brought to a focus on the surface of the concave mirror *M*. The light is then reflected back over its original path and once more falls on the slots or teeth of the disk. If the disk is moving slowly the eye sees a flickering image of *L*, but if the images succeed each other faster than twenty per second a steady image appears due to the persistence of vision. The brightness of this image depends upon how much of the light is stopped by the teeth on the disk. If the speed of the wheel is increased so that a tooth has moved into the position of a slot in the time of travel, the light is intercepted by the tooth and the image vanishes. At twice this speed the light would again appear at its brightest, at three times dark, at four times bright, and so on.

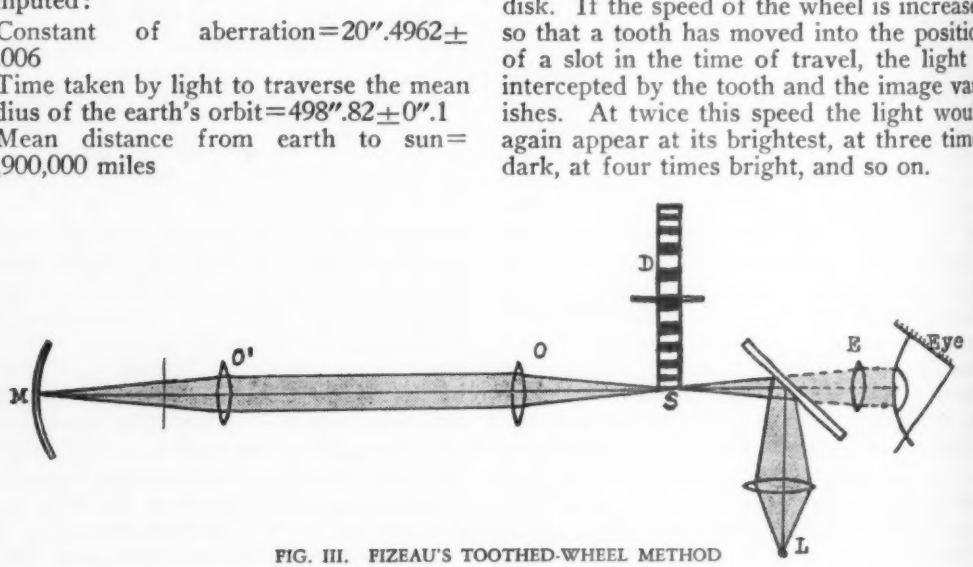

FIG. III. FIZEAU'S TOOTHED-WHEEL METHOD

With 720 teeth and a distance from S to M of 8.6 kilometers, with ω the angular speed of the wheel, and V the velocity of light, then for the first disappearance:

$$t=(2\times 8.6)/V=2\pi/2\times 720\times\omega$$

or for the nth disappearance:

$$t=\frac{2\times 8.6}{V}=\frac{(2n-1)}{2}\ \frac{2\pi}{720}\ \frac{1}{\omega}$$

from which V was computed by Fizeau as 195,741 miles per second.

Fizeau's method has been used to determine the velocity of light by Cornu in 1873, by Young and Forbes in 1881, and by Perrotin in 1900. Cornu increased the distance to twenty-three kilometers, and kept the speed of the wheel under the control of the observer and measured its speed by a hundredth-second chronometer. These refinements gave him a speed in vacuo of 300,400 kilometers per second. Perrotin increased the distance to forty kilometers at the Nice Observatory and obtained a velocity in vacuo of 299,860 kilometers per second.

Foucault's Method

In 1834 Sir Charles Wheatstone, by an ingenious method making use of revolving mirrors, had succeeded in measuring the speed of electrical discharge between two spark gaps a quarter of a mile apart, the mirrors revolving at about eight hundred revolutions per second and the images from the different gaps being displaced horizontally. In 1838 Francois Arago communicated to the French Academy the details of an apparatus utilizing revolving mirrors for finding the speed of light. Due to the rise of Louis Napoleon in 1848 Arago was kept busy in the important post of minister of war and of marine where "he effected some salutary reforms, such as the improvement of rations in the navy and the abolition of flogging." His eyesight failed in the spring of 1850 and the details of the method were turned over to J. B. L. Foucault. In 1850 by this method Foucault showed that the speed of light in a refracting medium, water, was less than that in air, but it was not until 1862 that he determined the absolute velocity of light.

In this true laboratory method Foucault allowed the light from a slit to fall upon a plane mirror which was revolving at about four hundred revolutions per second. This light was reflected successively to five other mirrors and returned over the same path to the revolving mirror after traveling a total distance of sixty-six feet. As the revolving mirror had moved in the interim the image would be displaced a fraction of a millimeter, as the time was only one fifteen-millionth of a second, and the speed of light was computed.

In this experiment the deflection was extremely small and of small intensity as it had to be turned aside to be observed, and even at its best was indistinct due to atmospheric disturbances, but it gave a value of 298,000 kilometers per second; with a probable error of at least 1 per cent.

Michelson—1878-79

Albert A. Michelson had graduated from the Naval Academy in 1873 where, according to Admiral Fiske in his *Memoirs*, he spent much of his time in the physics laboratory engaged in research rather than on the athletic field or engaged in distinctly naval pursuits. In 1875 he returned to the Academy as instructor with the rank of ensign and in May, 1878, made ten independent observations of the speed of light "under difficulties, and with apparatus adapted from the material found in the laboratory of the Naval School." These measurements indicated the improvements that should be made in order that the desired accuracy would be secured. By use of a lens of long focal length (150 feet), Michelson was enabled to reflect light over a distance of 2,000 feet. The time intervals were measured by means of the revolving mirror whose speed was kept accurately constant by means of a hand control on an air turbine, the speed being measured by the stroboscopic effect with a tuning fork of known frequency. Thus time intervals of four-millionths of a second were measured to an accuracy of 1 part in 200,000. A final result of 299,740 kilometers per second in air, or 299,828 kilometers per second in vacuo was obtained, a result which agrees amazingly well with the present weighted mean of 299,800 kilometers per second in vacuo.

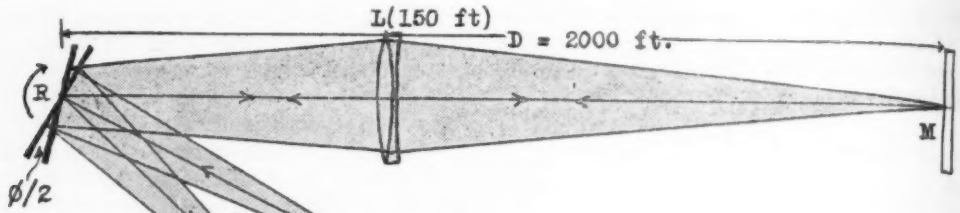

FIG. IV. MICHELSON'S VARIATION OF FOUCAULT'S REVOLVING-MIRROR METHOD

By reference to Fig. IV it is seen that light is reflected from the sun on a slit by means of a heliostat and mirror. The light from the slit which acts as an object falls upon a revolving mirror R at a distance of thirty feet where it is reflected through an opening in the building on to a lens of long focal length. It is there sent to a plane mirror M at a distance of about 2,000 feet where an image of the slit is formed. The light is then reflected back over its path and if the mirror R had not moved would be superimposed on the slit. But while the light was traveling twice the distance from the revolving mirror to the distant mirror, the revolving mirror had turned clockwise through an angle $\varphi/2$, and the reflected light will therefore be turned through an angle φ and the light will arrive at S' instead of S. With the mirror revolving at 257 revolutions per second a displacement SS' of 133 mm. was noted.

If D is twice the distance between the mirrors, r is the distance from the slit to the revolving mirror, d is the displacement of the image at the slit, φ is the angular displacement of the image, n is the speed of revolution of the mirror, and t is the time for the light to travel the distance D; and as there are 1,296,000 seconds of arc per revolution, then $\tan \varphi = d/r$; $V = D/t$; $t = \varphi''/1{,}296{,}000 \times n \times 2$; and $V = 2{,}592{,}000 \times D \times n/\varphi''$, thus the velocity measured is proportional to D, to r, and n, and inversely proportional to d.

The measurement of D was made by a standard steel tape whose temperature and stretch coefficients had been carefully determined, and which had been compared with a standard meter. The speed of rotation of the revolving mirror was measured by counting the optical beats between the revolving mirror and an electrically maintained tuning fork, and this was maintained constant by regulation of the air blast that drove the turbine which rotated the mirror. The electrically driven fork was compared with a standard Koenig fork, its temperature coefficient being known, and the time was regarded as known to within 1 part in 200,000, giving a speed of light as 299,895 kilometers per second.

To quote from Master Michelson's paper before the American Association:

> The site selected for the experiments was a clear, almost level stretch along the north sea wall of the Naval Academy. A frame building forty-five feet in length was erected at the western end of the line. . . . . It was found that the only time during the day when the atmosphere was sufficiently quiet to get a distinct image was during the hour after sunrise or during the hour before sunset. At other times the image was boiling, so as not to be recognizable.

Master Michelson resigned from the Navy and after several years of study in Europe at the University of Berlin, Heidelberg, and the École Polytechnique, was appointed professor of physics at the Case School of Applied Science. While there in 1882 and later at Clark University he continued his experiments, securing still more accurate values.

SIMON NEWCOMB—1882

During the progress of Michelson's research Simon Newcomb secured official support and, using essentially the same method,

made a determination on a still larger scale. He placed the reflector at Fort Myer, Virginia, across the Potomac River from the Washington Monument and the Naval Observatory where the readings were taken, so that the light traveled a distance of about seven kilometers. He maintained the position of the returned image constant by control of the speed of the mirror and in a run of about two minutes counted by means of a chronograph the number of revolutions of the mirror. The mirror could also be turned in either direction so that no zero reading need be taken, but merely the two extremes. A revolving mirror made of nickel steel and having four vertical sides was used. The final result was concluded to be: velocity of light in vacuo=299,860 kilometers per second.

Maxwell's Electromagnetic Method

James Clerk Maxwell, after a study of Faraday's scientific papers, published several mathematical treatises on the electromagnetic theory of light. The first paper was communicated to the Royal Society in 1867, but it was not until 1873 that the theory appeared in a fully developed form in his *Electricity and Magnetism*. Maxwell reduced all electric and magnetic phenomenon to stresses and motions of a material medium and proved that the velocity of an electromagnetic wave motion in a transmitting medium was $v=\frac{c}{\sqrt{\mu k}}$. He pointed out that in the ether, where the magnetic permeability μ is unity in the electromagnetic system of units, and the dielectric constant k is unity in the electrostatic system of units, that the velocity of light c is that of an electromagnetic wave disturbance v, and that this velocity is the radio of the electromagnetic and the electrostatic units.

When the same electrical quantity is measured in both electromagnetic and electrostatic units the ratio of the result is always a power of c, the velocity of light. For example: 1 volt$=10^8$ abvolts$=1/300$ stat volt, so that 1 stat volt$=3\times10^{10}=c$ abvolts; or 1 ohm$=10^9$ abohms$=1/9\times10^{11}$ stat ohms so that 1 stat ohm$=9\times10^{20}$ abohms$=c^2$ abohms.

Thus the value of the speed of light may be determined by purely electrical methods, the mean of determinations by J. J. Thomson, Rowland, Rosa, Thomson and Searle, Pellat, Abraham, Hurmuzescu, Perot and Fabry, and Rosa and Dorsey, from 1883 to 1907 gave as a value 299,300 kilometers per second.

That this speed may be determined without measuring either time or distance, but merely the ratio of two units in electricity, is indeed remarkable, and much more than a strange coincidence.

Michelson—1925-1929

Simon Newcomb, in an article in the *Encyclopedia Britannica* makes the statement:

> It seems remarkable that since these determinations were made (1882-3), a period during which great improvements have become possible in every part of the apparatus, no complete redeterminations of this fundamental physical constant has been carried out.

But during this period Dr. Michelson had been appointed head of the Department of Physics at the University of Chicago and had performed and directed much brilliant research. He had performed the Michelson-Morley experiment which showed that the speed of light was not changed by the motion of the transmitting body, and upon this experiment Einstein has based his theory of relativity. He measured the speeds of light in different media and showed that the index of refraction was inversely proportional to the speed of the light in the medium, a fact which killed the corpuscular theory and saw the rise of the undulatory or wave theory. He had invented the refractometer or interferometer which bears his name, and the echelon grating, and had measured the standard meter in terms of the wave-length of a standard light. Not until he was promoted to distinguished service professor of the University of Chicago and relieved of the arduous duties of supervision and teaching was he enabled to return to his first love, the accurate determination of the speed of light. During the summers of 1924 and 1925, again in 1926 and 1927, and now again in 1929, in California, Professor Michelson has and is determining this fundamental constant.

In the expression for the velocity by the revolving-mirror method the distance D between stations, and the speed of the mirror n, may be determined with great accuracy, but the angular displacement of the mirror, $\varphi/2$ cannot be measured with great enough accuracy. Newcomb suggested that a re-

volving mirror of prismatic form be used and the distance between stations be made so great that the return light be reflected at the same angle on the following face of the prism so that the object and the image would coincide. Between Mount Wilson and Mount San Antonio near Pasadena the experiment was tried over a distance of thirty-five kilometers, with a speed of rotation of 1060 turns per second and a four-sided mirror. With an octagonal mirror the speed of revolution could be reduced one-half. The faces of such a prism may be made accurate to within an error of one-millionth by means of interference fringes. The added accuracy of an audion circuit to maintain the tuning fork has been used.

In the summer of 1926 an assortment of mirrors of glass and steel having eight, twelve, and sixteen sides were tried and gave a weighted mean for the velocity of light in vacuo of 299,796±1 kilometers per second.

During the summer of 1929 Professor Michelson has been repeating the experiment at the Mount Wilson Observatory. A twelve-sided steel mirror driven by a small air turbine was formed by a single piece of steel. The flatness of each face is within one-sixth of the wave length of light and the mirror is vibrationless up to 47,000 revolutions per minute. The light is sent from Mount Wilson to Mount San Jacinto, a round trip of 165 miles, and hence must be of great intensity. This was obtained from the crater of a high-intensity searchlight lamp focused on a slit one-tenth millimeter in width.

A further refinement is to be tried at the Ross Flying Field, where permission has been secured to erect a pipe line three feet in diameter and half a mile in length. Dr. Michelson plans to pump the air from the pipe in order to get rid of the errors due to air resistance and to send the light back and forth several times in the pipe by special mirrors. An octagonal mirror will be used and adjustment of the speed be made until the returned image coincides with the object. Thus the velocity of light will be measured directly in vacuo, the dream of every physicist whose fetish is accuracy.

Fifty years have passed since Master Michelson measured the speed of light at Annapolis and started on his way to fame. The probable error of measurement in this time has decreased with the refinement of scientific apparatus until now it is no longer necessary to secure any greater accuracy than that obtained by the former master. In a reminiscent talk before a recent graduating class at the Naval Academy Dr. Michelson said: "When I resigned from the Navy my classmates, who are now admirals, prophesied many dour happenings for me, but now I would not be surprised, if in certain quarters of the globe, the experiments that I have performed would give me a rank almost equal to that of these same admirals."

Rank is not always the essence of accomplishment, and perhaps Dr. Michelson's statement is correct. After all the Navy lost a potential admiral, in order that the world would gain an eminent physicist, whose minuteness of detail, accuracy of determination, and brilliance of research have made him by popular consent the world's greatest authority on light.

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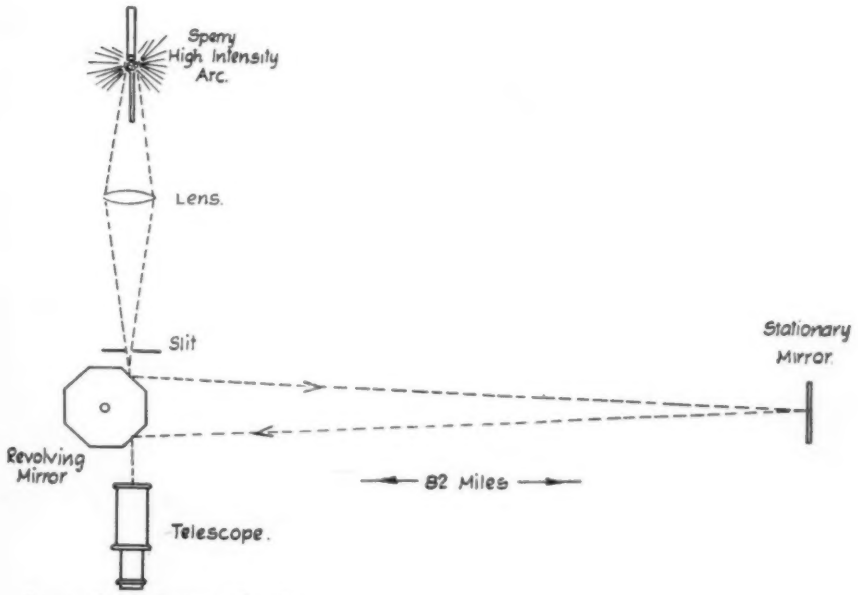
Artificial sunlight used for the light speed measurements was obtained from a Sperry high intensity searchlight lamp

Revolving reflector with cover removed which Dr. Michelson used for his light speed measurements.



Courtesy Sperry Gyroscope Co., Inc.

Schematic drawing showing how Dr. Michelson employed these different instruments in his light speed measurements. (See opposite page)

From a painting by William Steeple Davis *Copyrighted*

ON THE MOONLIT SEA

Courtesy of Harlow, McDonald and Co., N.Y.

U.S.S. *LOUISIANA*

From a painting by Charles R. Patterson

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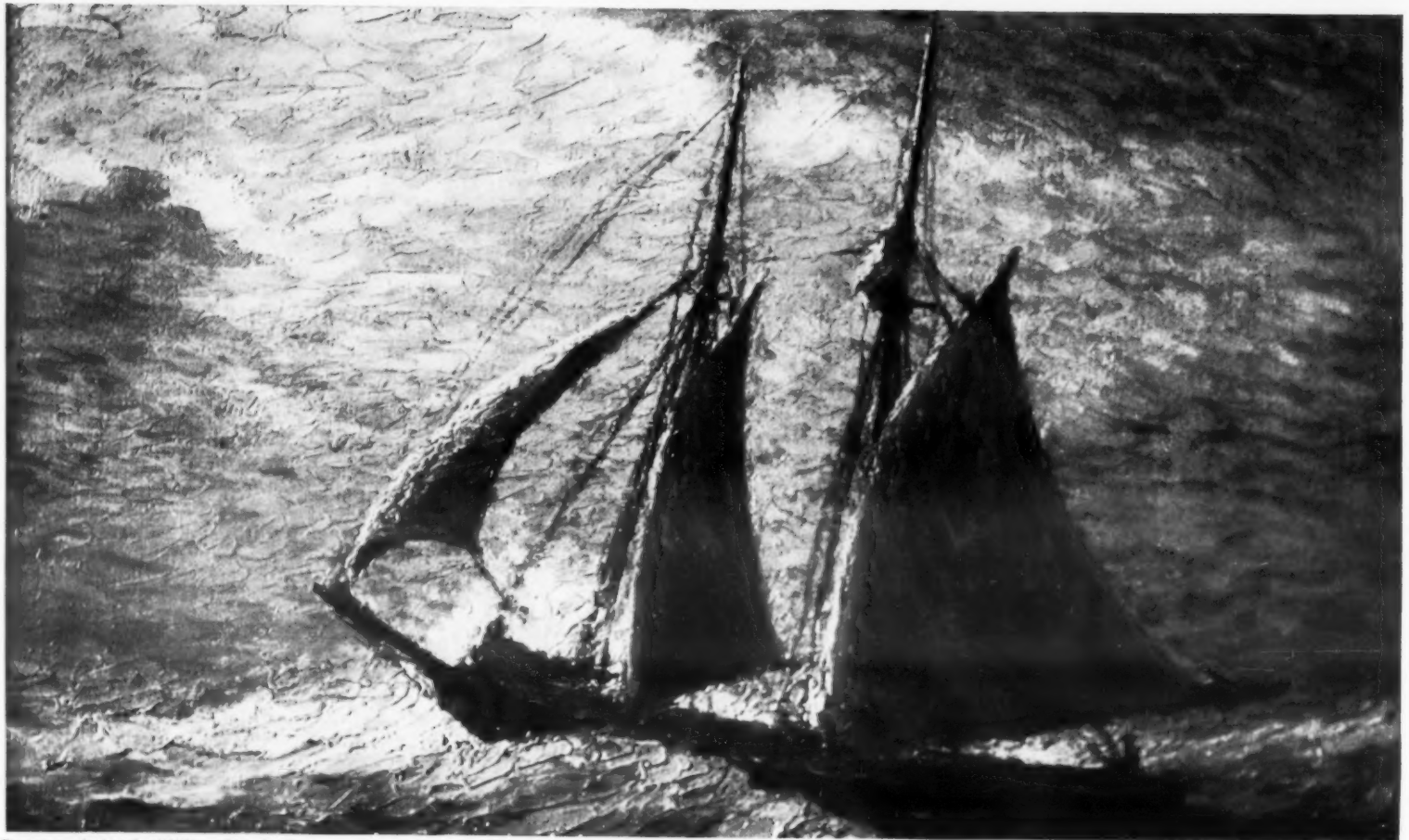

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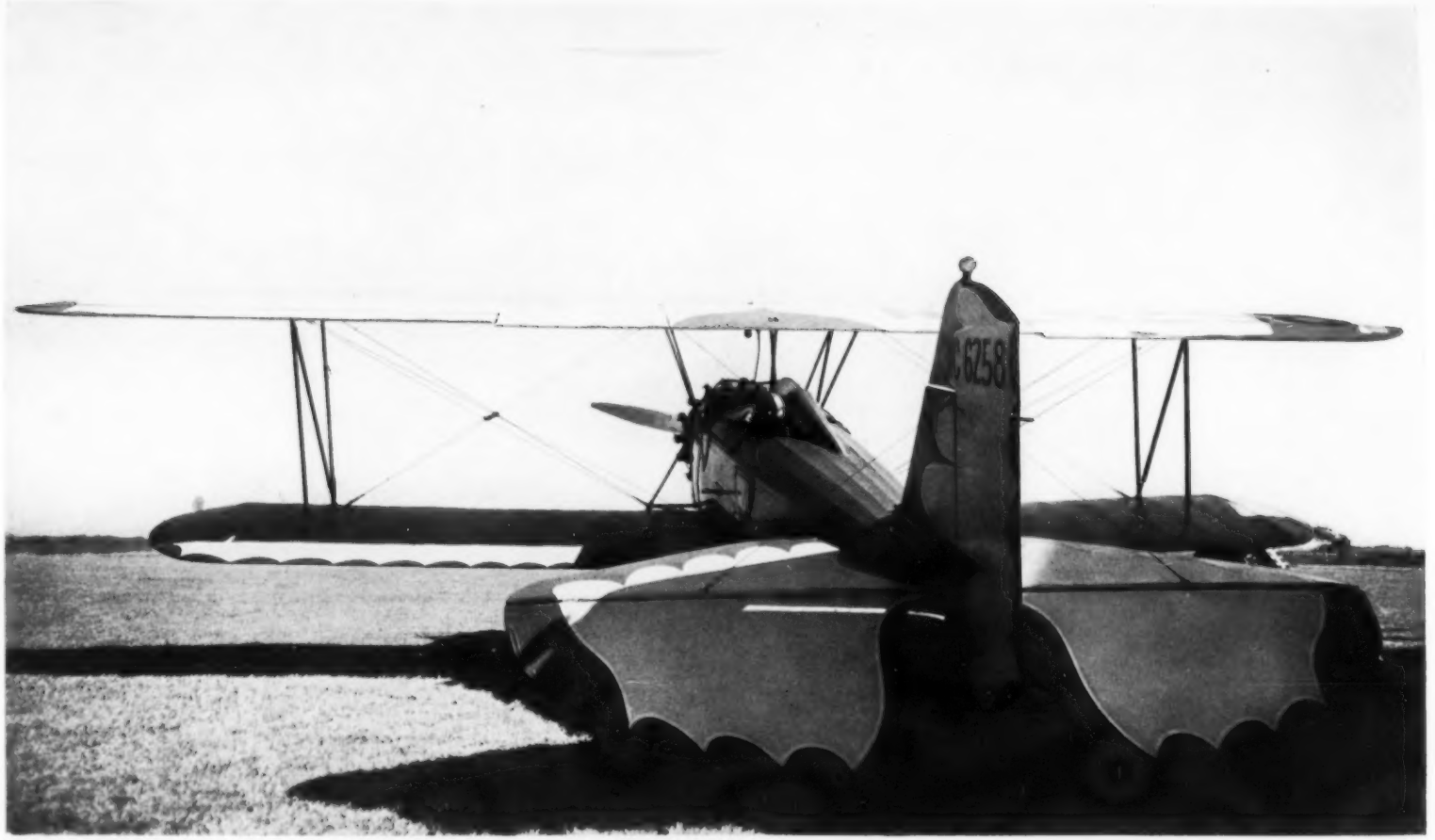
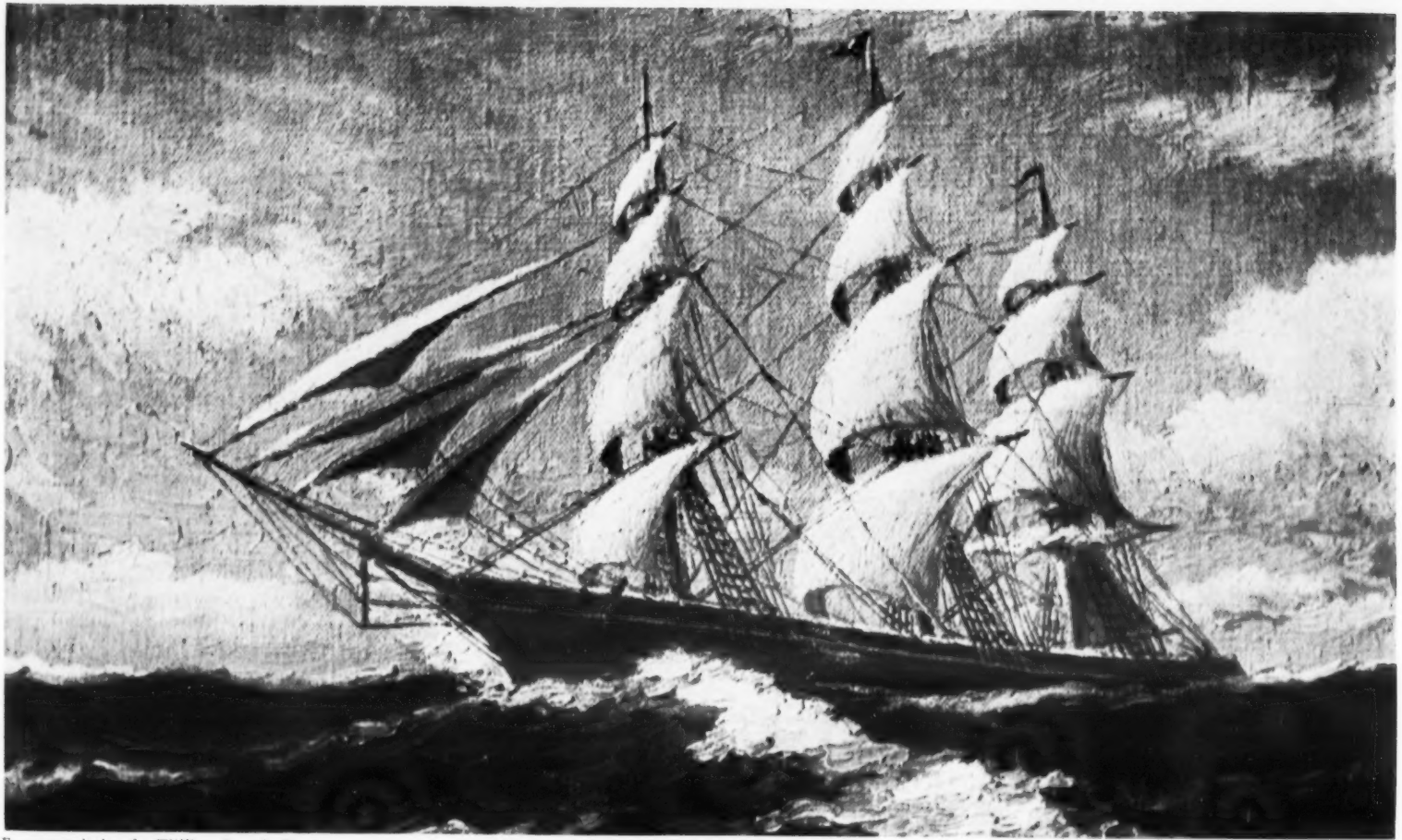
WINDY WEATHER
A familiar type of Gloucester fishing smack.

WINDY WEATHER
A familiar type of Gloucester fishing smack.



By Ewing Galloway, N.Y.

MAN GOES TO THE MOTH FOR DECORATIVE DESIGNS FOR HIS NEW-FOUND WINGS
This Stearman aëroplane with its special paint job looks like a great lunar moth. In flight it is particularly beautiful with the sun shining on its blue and gold wings.



From a painting by William Steeple Davis

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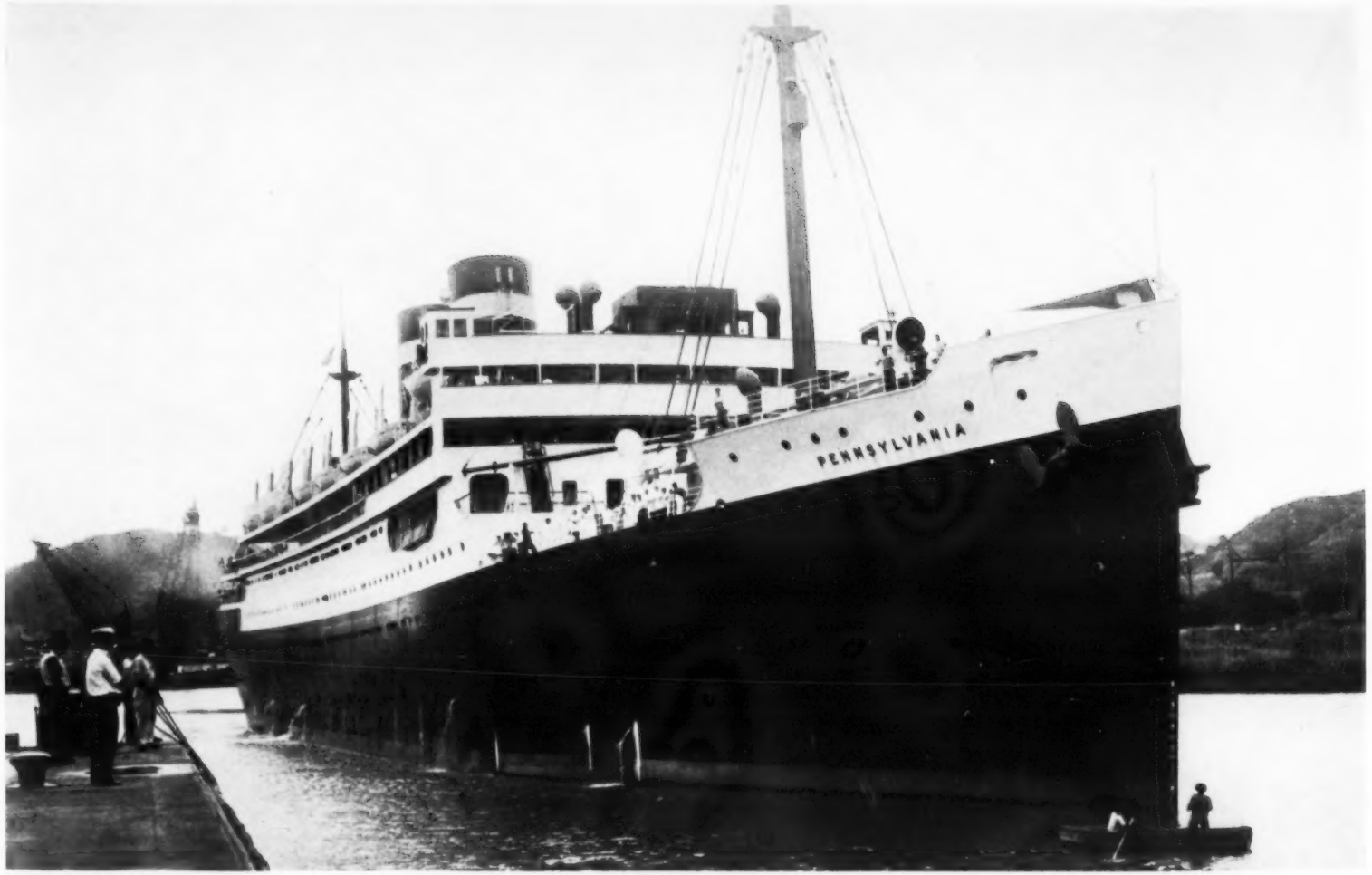
DRIVING ALONG
A clipper type running before the wind.

A clipper type running before the wind.



Panama Pacific Line Photo

A NEW "QUEEN OF THE SEAS"

Turbo-electric liner *Pennsylvania* is shown entering Pedro Miguel Locks of the Panama Canal on recent maiden voyage to Californian ports from New York. Ship is 613′ long; 80′ beam; 100′ from keel to bridge deck; 32,816 tons displacement. Largest liner built in an American shipyard. Launched last July at Newport News, Va.

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International News Photos, Inc.

DESCENDANTS HONOR THE "PATHFINDER OF THE SEAS"

Great grandchildren of Matthew Fontaine Maury standing before the monument erected in his honor at Richmond, Va., and unveiled on Armistice Day, 1929.

The Capture *of the Palmyra*

An Inspirational Historical Sketch

By CAPTAIN J. M. ELLICOTT, *U. S. Navy (Retired)*

OUT OF notes made from some old letters which once passed through my hands I have reconstructed this little historical sketch and believe it will prove inspiring as well as interesting.

Not many years after our War of 1812, the United States Navy was called upon to perform service in keeping the peace as arduous as that in maintaining war. The great revolt of Spanish America against Spain broke out, and spread over all Spain's possessions in America except Cuba and Porto Rico. From these two bases, therefore, Spain tried to fit out naval forces to blockade the ports of Venezuela and Colombia, through which the "patriots" received their supplies. Not having an adequate regular navy, she commissioned privateers. Lawless adventurers owning vessels took advantage of this to such an extent that the blockade was soon transformed into outrageous piracy on the high seas, by which United States commerce with the West Indies, and South and Central America was almost paralyzed. Our government then sent a squadron to the West Indies under Captain James Biddle, who visited the captain general of Cuba and asked him to coöperate in suppressing piracy so far as to allow our vessels to run into Cuban waters and land in pursuit of pirates. The captain general refused, saying with grandiloquent vagueness that he was taking ample measures himself for the suppression of piracy.

In Captain Biddle's squadron were several schooners of twelve guns and 100 men each, which were kept cruising between Porto Rico and the Spanish Main to protect our commerce on the high seas. One of these, the *Porpoise,* Lieutenant James Ramage commanding, sailed from the island of St. Bartholomew, July 6, 1822, intending to run down before the trade wind along the usual sailing route to Curaçao, looking out for pirates. About sunrise the next morning, Lieutenant Ramage saw in his path two fine brigs. They had hoisted the new Mexican colors and were apparently waiting for him. Feeling sure that their colors were false, and despite the fact that, if armed, they were vastly superior to him, he hoisted the Stars and Stripes, cleared ship for action, manned his guns on both sides and shaped the *Porpoise's* course so as to run directly between the two waiting vessels. The brigs probably took the *Porpoise* for an American merchant schooner running with blind confidence right into their jaws, for, as she came between them, the one to windward fired one gun only and hoisted Spanish colors instead of Mexican. To his surprise, no doubt, his gun was instantly returned by one from the *Porpoise.* The leeward brig then changed to Spanish colors and fired. She got not only a shot in return, but the American changed course and ran directly for her. Such a turn of affairs proved quite demoralizing. Her crew fell into great confusion, firing grape shot and musketry in quite a harmless manner until they realized they were confronted by a whole broadside of guns on the schooner, and that these were about to be fired at close quarters. Then they abruptly desisted and awaited developments. Lieutenant Curtis of the *Porpoise* boarded the nearer vessel and found by her papers that they claimed to be two Spanish brigs of war, the *Palmyra,* of fourteen guns and 130 men, and the *G. Boves,* of eight guns and 100 men, both from Cadiz. The senior officer in command wrote Lieutenant Ramage the following letter in explanation of his conduct:

S.N.B. G. BOVES,
At Sea, July 8, 1822

M. Ramage, U.S.Sc. Porpoise,

SIR: I am sorry you will be incommoded with me by firing you this morning, being the case that we thought you were "patriots," and we have commission from our government to blockade all the men ports, and happened that must all the vessels from the men hoisted and fight with the American flag, we took you to be one of them.

I remain your sincear, etc.,

PABLO FLUAGER

The letter becomes intelligible by reading "main" for "men" and "most" for "must." Lieutenant Ramage felt obliged to accept the apology and let the brigs proceed, but as a precautionary measure he bore up for St. Thomas, where he arrived next day and communicated his action and suspicions to the Secretary of the Navy; he then resumed his course for Curaçao.

Just one month later, the American trading schooner *Coquette,* of Georgetown, D.C., Captain John Souther, was en route from St. Bartholomew to St. Thomas. At daylight on August 9, Captain Souther was aroused by the boom of a gun and found a vessel crowding on sail in chase of him. As the shot came dangerously near, he obeyed its summons with alacrity and hove the *Coquette* to. The chasing vessel, a handsome hermaphrodite brig with a red streak around her hull, ranged up near him and sent a boat alongside flying Venezuelan colors. An officer and some men came on board the *Coquette,* demanded the ship's papers, searched the vessel, including her cabin, berths, chests, etc., taking what they pleased of the cargo as well as the clothing and other personal effects of the captain and crew.

The looted vessel, when released, hastened to St. Thomas (whither, Captain Souther knew, the U. S. Schooner *Grampus* had preceded him from St. Bartholomew with a convoy on August 7), arriving next morning. Captain Souther, to his great joy, found the *Grampus* there and immediately told his story to her captain, Lieutenant Commander Gregory, U.S.N.

Commander Gregory had already learned of other depredations by the same brig or vessels like her. On the fourteenth he sailed from St. Thomas for Curaçao with two valuable merchant vessels in convoy and with his mind made up to avenge the *Coquette* if he got the chance. A keen lookout for the vessel described was kept and, sure enough, just before dark on the following evening, when to the southward of St. Croix, he saw a hermaphrodite brig, apparently armed, coming down on his weather quarter. It was too near nightfall to make certain of her character, so the *Grampus* was kept on her course with her convoy until morning, when the first light of day showed the same strange vessel right ahead. Commander Gregory saw his advantage in a moment, and leaving his convoy safely hove to to windward, crowded on sail and chased to leeward after the suspicious looking stranger. By half past nine he had gained considerably upon her and she hoisted English colors. At ten the chased vessel, evidently realizing she was sure to be brought to bay, hauled down her British flag, hoisted Spanish colors and fired a gun defiantly to windward. Half an hour later she hove to and hoisted a white flag at the fore. With inexpressible delight Commander Gregory noted, as he neared her, that she had a red streak around her hull. At twenty minutes past eleven he laid the *Grampus* within pistol shot under the brig's lee and demanded her surrender as a pirate. Her captain replied that he did not understand the hail and asked that it be repeated. As Commander Gregory was doing so the brig poured a whole broadside, both from cannon and musketry, into the schooner, but the treachery availed nothing. The *Grampus'* gunners, lock-strings in hand, were waiting with almost uncontrollable eagerness for just such an outcome. The broadside was returned even as it flashed from the brig's ports.

The battle lasted three minutes and a half. At the end of that brief fight the brig struck her colors, a complete wreck and in a sinking condition, with one man killed and six wounded. Three large shot had pierced her between wind and water, one of which had disabled her pumps. The *Grampus* received some trifling injury in her sails and rigging but not a man hurt.

Lieutenant Voorhis of the *Grampus* was sent to the sinking brig and by almost superhuman effort succeeded in stopping her leaks. She proved, as expected, to be the notorious *Palmyra,* still carrying her plunder from the *Coquette.* Her captain acknowledged the robbery of that schooner and naïvely remarked that they could not help those things happening now and then.

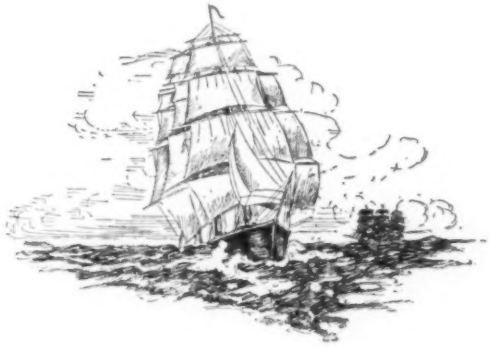
Commander Gregory took his prize back to St. Thomas, patched her up, and then took her to the United States, arriving safely with brig and prisoners in Charleston, South Carolina, September 12, where the latter were lodged in jail and the former libeled and turned over to the United States district attorney.

When the action of the *Grampus* became known the fury of Spanish officials was unbounded. The captain general of Porto Rico, Don Francisco Gonzales y Linares (possibly an ancestor of the general commanding at Santiago in our war with Spain) wrote Captain Spence of the *Cyane*, then conducting our operations in the Caribbean, letters white hot with invective. Extracts from Captain Spence's replies will fittingly close this narrative.

We require that our lawful commerce shall be unmolested; that our vessels shall not, from frivolous causes, be intercepted.

What armed vessel could expect to fire at an American ship of war with impunity?

There must be safety in peace, or its best objects are defeated; there must be security on the great thoroughfare of all nations, otherwise its best purposes are perverted.



The Spiritual Value *of* Discipline

By Corporal William W. Childs, *U. S. Marine Corps*

EXCEPT in time of peril, those who devote the best years of their lives to the maintenance of national security are looked upon by the majority of the civilians as outsiders, almost outcasts. This opinion applies only to the enlisted men and is possibly sometimes merited. Nevertheless, the enlisted man, by reason of his occupation, should be given the benefit of the doubt. It is because most people are unable to comprehend the kind of life a service man leads that this attitude is so prevalent. It is my purpose to show in this article that the soldier, the sailor, or the marine is in most cases simply ordinary human material which has been subjected to a strain and a test, and that these actions have destroyed certain tendencies and built up others—a true spiritual metabolism. As an example of the period of destruction and construction to which I refer I will use the training period at Parris Island, which presents a fairly accurate picture of life at any American military or naval training station.

On the surface Parris Island is a place where certain young men who have decided to "see the world through a porthole" come for initiation into the mysteries of the life of a sea soldier. It is true in a great many cases that those who go through the training there never get a glimpse of what is happening to them spiritually. On the other hand, there are those on whom the sudden immersion into military discipline has the effect of hot iron dipped into cold water. It hardens and tempers them—and they know it. It is with this type of man that this essay will deal.

It is a significant fact that the kind of man who goes through this period of spiritual turmoil is the type who is most likely to say nothing of it; so that to a casual observer it does not seem to exist. But I myself have felt the sensations about to be analyzed and have had the opportunity to discuss these matters with others, who, under the seal of friendship, were only too glad to talk of their problems with anyone who was willing to help them find a path through the jungle of strange emotions. I therefore feel qualified to prove that to a large number of men the training received at Parris Island, and indeed at other naval and military training centers, is a stepping stone to fine character. The ultimate value of character in the life of a man or a nation there is no need to discuss.

The approach to Parris Island gives a hint of the kind of experiences one is to undergo. From Atlanta to Port Royal the familiar landscape fades. The towns become smaller and smaller. The nature of the country changes. At last one begins to wonder what kind of strange beings must inhabit a region so remote. The first whiff of the marshes and the sea makes one's chest swell—it is a taste of the new life.

The trip from Port Royal to the island strengthens the conviction that one has embarked upon a romantic adventure. It is this element of strangeness that lifts one's mind from the old familiar mode of thought, tautens the fibres of the spirit, and prepares one for the new experiences he is to undergo. Silence and a feeling of uneasiness are strangely noticeable. . . . . Even the most world-weary tramp is seen to tighten his lips and glance apprehensively at the buildings as the training station comes into view.

From the time we are sworn in until our training is over and we scatter to the ships and stations of the corps, we are continually subjected to new influences. Paradoxical as it may seem, the fluidity of our experiences, the constant change and stress of new modes of thought, tend to make us stolid. We protect ourselves with the armor of indifference. It is this apparent immobility of emotion which renders the true character of a service man so difficult to get at. We protect our feelings from hurt by this means, but underneath it all they pulse and quiver

as strongly as ever. We become machines; we act often without thinking. Obedience becomes instinctive. And it is good. Because we first do the thing and then reason about why it was done, we reach a clearer understanding of the truth than we would have if our actions had been dictated and colored by the prejudices of our reason. It is this method of doing things that makes the service man, at last, a different being from the man he would have been in civilian life.

The ordinary enlisted man does not acquire a great amount of knowledge in the service; but what he does gain is so ingrained in his mind as to be almost instinctive. Certain thoughts and actions become habitual. To make certain of the necessary actions of military life like this is the ideal of martial pedagogy. Now let us see how some of these changes are brought about.

We reach our training station with the habits acquired in the irregularity of civil life fresh upon us. We are immediately subjected to the domination of the clock. There is a time for everything, and one time only. All speech with certain people must be uttered in a set form. All actions must be accomplished in a certain manner. We must eat, sleep, work, and seek recreation at prescribed intervals during the day. At first it is hard. We cry out for relief from the monotony, but it goes on, endlessly. At last we realize that it is no longer difficult to perform our duties; they have become habits. One at a time, every action slips into place until at last we are fit to be termed soldiers.

It is during this period that we lose most of our old ways of thinking. We learn that such and such a thing must be done under any circumstances; we see many easier ways of doing it, but are not allowed to try them. In the barracks the more delicate of us are thrown with the coarsest and we acquire some of their grossness. On the drill field we forget all our prejudices in the sweat and pain of marching. We return from drill to eat; our appetites are enormous and the food seems limited; some grab and growl like starved animals. After each meal a sense of repletion and ease overcomes us, and all the trials of the past are forgotten. Thus the time passes until at last we begin to realize that it's not so bad after all. Competition sets in, the unit begins to take on smartness. The training is almost ended. Pride is at last making itself evident.

Now we begin to realize that we have somehow changed. The things that would have shocked us before no longer do so. We have been toughened. We expect no favors from fate. Duty must be done. We are products of the military machine. It is remarkable the feeling of confidence we experience the first time we leave the island and come in contact with civilians again. We know we have just gone through a gruelling experience and have come out winners. This spirit is never lost. It sticks with us and comes out on occasions of trial to make us firm and confident. It is well worth the trouble to acquire. And among the other things we have learned is the knowledge that facts must be faced squarely. We have been made to do so many unpleasant things that now there is nothing that frightens us. We may growl, and generally do, but the thing gets done. We find that nonessentials have been lost, but that the basic qualities of our nature have been strengthened.

It is to be regretted that a few of the men who enlist into the service of this country are moral degenerates. However, it may be said with distinct pride that in every case these unfortunates receive their just reward and sooner or later are placed where their presence cannot contaminate. But few barracks are absolutely free from the milder forms of obscenity, and these provide another influence toward making a truly worthy man of him who has the mental caliber to assimilate the knowledge without acquiring the attendant vices. It is never good to hide an unpleasant thing. It is far better to bring out the worst aspects of a situation—and overcome them—than to dodge and hide from the ugliness. We analyze the effects and by revulsion are rendered immune to their influence. This contact with disgusting reality has a most beneficial effect on character. It serves to show the depths to which a human being may sink; it warns us of the possibilities of our own nature. We are forewarned and forearmed.

It is during this period that we first learn how rare a thing is a man fit to be called a friend, but we also learn how valuable such a man is to us when found.

During the routine drill and work of the day these things do not come home to us, but at night when stationed on some quiet

sentry post with nothing but the stars to disturb the operation of our minds, we feel the influence of new life working in us. Quiet, patient courage is being born in our souls. Perhaps we think of all that we have left on the outside, and make a silent resolve to go back some day, armed with the self-reliance acquired through struggle and discipline, to win love and a place in the social structure. Often a group of us have sat in the guard house before going on watch and confessed our weakness and our strength to one another, never guessing that we were in this way educating ourselves in the intricate workings of the human soul. The language of these talks was coarse but the spirit was good.

A sergeant once told a group of us that he would not take ten thousand dollars for the privilege of having gone through recruit training, and that he would not go through it again for the same amount. This serves to show that the experience is unique and lasting. When I left the island I realized fully, for the first time, that I had been torn apart spiritually and rebuilt on a more solid foundation. Never again could the utter hopelessness and futility of life appear so vividly to me as it had during those weeks when I seemed to be merely an infinitesimal cog in a vast machine. Never again could vice be seen so clearly. I had undergone my baptism of fire. Perhaps this may seem unduly mystical to those who have not undergone the experience, but I know that it is true in my case and I have never met any other service man who could deny the change in his outlook on life brought about by the training. This process of regeneration does not stop with the departure from the island, but is continually at work during the entire term of our enlistment. But the initial period is over. Thereafter, it is a repetition and confirmation.

It has been my endeavor to show in the preceding paragraphs that, although a man in the service may seem rough and uncouth, may sometimes appear vulgar and brutal, there is under the hard exterior a purity and humanness that most people never sense. He is a product of his training and environment. He is a precise instrument with a definite use in the world. But above all he is a man.

The enlisted man is a refined, tested, and case-hardened tool in the hands of a skilled workman. His training has fitted him to meet certain conditions in the life of a nation, but in the process he has acquired a new and valuable set of ideas. During the years when the character of a man reveals itself he has undergone a series of severe trials, and these hardships will leave an indelible mark upon his life. In times that require the qualities of courage, determination, patience and a clear-sighted facing of facts, he will show his training to perfection. Superficial sympathy will be lacking, but true kindness is there.

It is well to remember in criticizing the enlisted man that instances of depravity within the service are more easily noticed than in civilian life. The soldier is almost always under the eyes of the public and must, therefore, maintain a far higher standard than a civilian. That he does this is evident.

It is also well to keep in mind the fact that these men have voluntarily offered to risk their lives for the protection of the things most valued in life. Because of this they are entitled to respect and to the sympathetic interest of the people with whom they come in contact. Sad to relate, this is seldom the case. We are damned for the faults of a few.

But no matter what the people think of us, we know that the strength and patience and determination acquired during our novitiate are things more valuable than jewels. We are self-reliant in the knowledge that life holds boundless possibilities of happiness for us in our chosen professions. Having seen the worst of life we can hope for the best. Having undergone the hardest physical trials we are prepared to labor untiring. And we will bring with us on our return to civilian life a stability and patience that will be invaluable in this time of change.

PROFESSIONAL NOTES

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UNITED STATES

Mr. Hoover's Address

Washington *Post*, November 12.—Millions of individuals here and abroad will be encouraged when they read the Armistice Day speech of the President of the United States. They will draw comfort from the fact that the head of the strongest nation in the world is striving with might and main to find a way to prevent wars. Americans will applaud his sentiments as expressing the true spirit of America, while foreigners cannot but feel that the United States may be depended upon to take a leading part in effective steps to maintain peace.

Mr. Hoover does not indulge in the day-dream of a blissful peace accomplished by mere example. He does not advocate the scrapping of ships and arms by this country as a means of inducing other countries to follow suit. Indeed, he recognizes the massive fact, always ignored or distorted by pacifists, that lack of defense is provocative of war. The world is under arms; with 10,000,000 more active and reserve soldiers than before the late war. Combatant ships have been decreased somewhat, but aircraft and other war weapons are more potent than before the war. The President reminds the country that experience gives warning that wars are to be expected. At the same time, the world is more genuinely inclined toward peace than ever before. The almost universal adherence to the Kellogg pact is a most significant proof of this progress.

The danger to peace lies in controversies which cannot be prevented from arising, because of commercial rivalries, the pressure of peoples for self-government, boundary disputes, and competition in armaments. The problem is to set up methods whereby controversies can be settled by peaceful means, and to eliminate competition in armaments. Mr. Hoover significantly suggests that the United States has need "under proper reservations" to support the World Court. As for the method adopted by the League of Nations, that of using combined international force to compel nations to "be reasonable," Mr. Hoover bluntly states that "we have refused to travel this road." He holds that in the Western Hemisphere, at least, public opinion may be so organized as to check violence. If European nations will ponder this statement they will perceive that the secret of peace lies in adoption of the rule that government shall be based upon the consent of the governed.

Although Mr. Hoover admits that future wars are more than probable, he very briefly dismisses the problem of freedom of the seas by suggesting that it will become an academic question if the nations succeed in establishing peaceful methods of settling controversies. Undoubtedly, denial of freedom of the seas to neutrals in time of war is itself a cause of war, and has driven the United States into two wars. This problem should be tackled and settled while there is peace, for when war occurs abroad the United States may have no other recourse than to make war in defense of its right to use the seas for peaceful and neutral commerce.

The novel suggestion is made by Mr. Hoover that food ships be made free of any interference in time of war. He would place them on the same footing as hospital ships. Nations which are dependent upon food from abroad are compelled to provide naval protection as a safeguard against national starvation in time of war. The humane instinct of every one supports the idea that women and children should not be starved because of war. Mr. Hoover answers doubts as to the practicability of the idea by citing the experience of the Belgian Relief Commission, which delivered more than 2,000 shiploads of food through two rings of blockade and did it under neutral guarantees continuously during the war.

Again, unfortunately, the immunizing of food ships during war clashes with the very purposes of modern war. Nations now fight with all their resources. Everything is contraband if destined to the enemy, and food most of all. The effect of a rule immunizing food ships carrying relief to women and children would be as much as one belligerent saying to another: "We propose to destroy only your male population of fighting age, but we are willing that your nation should have means of carrying on the war to destroy us. You can have food, but you must not give it to your soldiers or sailors." This arrangement would require that each belligerent should have supervision over the distribution of food in the enemy country—a preposterous situation.

Many British authorities contend that the blockade of Germany was the real force that

gained victory for the allies. The protests from Germany during the war indicate that the starvation blockade helped mightily to bring Germany to terms. It can not be expected that a nation fighting for its life will permit food to go to the enemy if it has power to prevent it. The suggestion for immunizing food ships, like that for abolishing gas, submarines, and other war weapons, may be applauded in theory as making war more humane, but war cannot be made humane. As Mr. Hoover himself observes, the implements of war are now more deadly than ever before.

The proper rôle of the greatest nation in the world, seeing that it is peace-loving and nonaggressive, is to be and remain so strongly armed that it can compel others to leave it alone. As civilization advances, governments will come more and more under the control of their own peoples. The greatest contribution to the cause of peace in the world was the establishment of the Republic of the United States. Other nations please copy.

GREAT BRITAIN

The Singapore Base

London *Times*, November 14.—Mr. Alexander, First Lord of the Treasury (Sheffield, Hillsborough), replying to Sir A. Sinclair (Caithness and Sutherland, L.) and Sir N. Grattan-Doyle (Newcastle-on-Tyne, N., U.), said that his Majesty's government gave attention to the question of the new naval base at Singapore as soon as they came into office. In 1924 the previous Labor administration decided not to proceed with the proposed naval base. Since that date, however, the action of the late government had altered the situation very materially. A floating dock had been provided at heavy expense, and in September, 1928, a contract was signed for the building of a large graving dock at a cost of approximately £4,000,000. Moreover, the bulk of the expenditure up to the present time had, they found, been met by contributions from Hongkong, the Federated Malay States, and New Zealand, their total contributions to the end of the present financial year being £2,113,000, together with the free gift of the site by the Straits Settlements. The house was aware that a naval conference had now been arranged, the decisions of which might affect the question of the use of this base, and in all the circumstances the government had decided that the work already contracted for at Singapore should be slowed down as much as possible, that all work that could be suspended should be suspended, and that no new work should be embarked on pending the results of the work of the Five-Power Conference.

Replying to supplementary questions, Mr. Alexander said that notification to the Dominions had been made on more than one occasion, and there was no reason to suppose that the nature of the answer he had given was out of harmony with their immediate view. But he would like to let that matter wait for a little longer before he gave a definite answer.

New Cruisers

London *Times*, October 28.—It is officially announced at Portsmouth that the new cruisers due for completion in 1930 are to join the Atlantic Fleet in relief of ships of war design. The *York*, the anticipated date of completion of which is March, will replace the *Canterbury;* the *Norfolk*, due for completion in May, the *Comus;* and the *Dorsetshire*, which should be ready in September, the *Frobisher*. All these ships to be relieved are in the Second Cruiser Squadron. The drafting of new cruisers into a squadron in home waters is in the nature of a return to pre-war practice. Since the Armistice such vessels have been sent abroad. The later "D" class ships went to China, the "E" class to the East Indies, the *Kent* class to China, and the *London* class to the Mediterranean.

New Sloops

London *Times*, October 18.—The two sloops of the 1929 program which it has been decided to name the *Shoreham* and the *Fowey* are being laid down this autumn at Chatham and Devonport instead of in the spring of 1930. This is partly to compensate for the loss of work involved in the stoppage of the cruisers *Surrey* and *Northumberland*, but the relief can only be temporary and incomplete, since the cruisers would have involved work to the value of about four millions sterling, whereas the sloops, less than one-tenth as large can be built for a quarter of a million. These postwar sloops all take the names of minor seaports of the country. The *Bridgewater* and *Sandwich* were authorized in 1927 and are now serving in China. Four more were or-

dered in 1928, the *Penzance* and *Hastings* at Devonport and the *Folkestone* and *Scarborough* from Messrs. Swan Hunter and Company, Wallsend-on-Tyne. The 1929 program includes six more, but only the *Shoreham* and *Fowey* are at present being begun, in advance of the regular program to prevent some of the discharges from the dockyards which would otherwise be necessary.

ITALY

Proposed Abolition of Submarines

London *Times*, November 9.—In view of the belief that Italy is now reconsidering her previous attitude of uncompromising hostility towards the abolition of submarines, special interest attaches to a recent article by "Sirius" in the *Mattino* of Naples. The *Mattino*, especially since its recent change of ownership, is now a strongly authoritative organ, and it is obvious that an article such as the one in question would not be published without the previous consultation and consent of the authorities.

After briefly reviewing the history of submarine operations during the war, the writer proceeds to examine what would be the position of France and Italy in the event of their abolition. France, he says, clearly cannot favor such a proposal. Were France at war with one of the two greater naval powers she would be blockaded whether submarines existed or not. But if submarines did exist she could at any rate hope to undertake considerable reprisals. If France were at war with Italy she would have little to fear from the comparatively few Italian submarines, especially in the Atlantic, whereas she could exercise a strict blockade against Italy by employing all her submarines in the Mediterranean. Consequently France has every interest to maintain the right to use submarines and even to oppose any reduction.

The case of Italy, the writer proceeds, is less easily disposed of. If Italy were at war with England she would be closely blockaded, and all Italy could hope to do would be to exert vigorous but limited reprisals in the Mediterranean, which, though a most important waterway for the British empire, is not absolutely vital, since it can be avoided by more roundabout routes. If France were the adversary, Italy would be blockaded without the possibility of exerting corresponding retaliation owing to her geographical and strategical situation.

On the other hand, if submarines did not exist, the Italian surface fleet, if intelligently and actively employed, could render a French blockade a risky proceeding, and consequently Italy's chances of receiving raw materials and of resisting would be greatly increased.

FRANCE

The "Surcouf"

Naval and Military Record, October 30.—The *Surcouf* submarine is to be launched at Cherbourg on November 18. This *sous-marin de croisière*, as she is officially called, belongs to the 1926 program, and is thus rather belated. She is inspired from the British *X-1*. Her designing, very carefully performed, required two years of preliminary studies and experiments, Paris well knowing from past experience how much it costs to leave anything to chance in submarine construction. She is credited with 3,257 tons when on the surface and with 4,304 tons when in the submerged position, being thus larger than the *X-1* by some 1,000 tons, or nearly one-third, which means in practice very much for underwater craft. She is also much bigger than the latest American submersibles of the "V" series although American specialists are known to have prepared plans for still larger underwater cruisers than the *Surcouf*. The largest Italian submarine building does not exceed 1,800 tons in submerged displacement, which is rather high for vessels intended exclusively for Mediterranean use. As to the *Surcouf*, she is, of course, essentially an ocean ship, with a radius of action of over 13,000 miles at twelve knots, intended to act in the two-fold capacity of cruiser and of submarine. Her length, that is believed to approximate 120 meters, and the great height of her upperworks above her keel (some thirteen meters) will make it dangerous for her to carry out evolutions in coastal sectors, and she will only on the high sea obtain her full freedom of movement, all the more so as her hull has been made abnormally robust with a view to diving with impunity at great depths, at over 130 meters and probably much deeper. No doubt is entertained as to her being a success from a navigating standpoint, although her freeboard (when on the surface) will not be substantially greater than that of the British *X-1*.

As her cost is relatively tremendous, and she will need a crew of 150 men, she is con-

sidered generally as representing too many eggs in one basket. Her loss would be a great blow, as she will be alone in the service for her special duties, her projected sistership not being likely to be built. She is too large and too cumbrous for fleet work; for such a purpose the small but handy and reliable *sousmarins de défense côtière* of the *Sirene* type are better than she could be. To act single handed on the ocean is her *raison d'être;* and she would eventually be the French *ultima ratio* of colonial defense, being capable of reaching at one stretch Madagascar by the round-the-Cape route. She would be most formidable when fighting underwater, for her massed tubes forward and on the sides are designed for the salvo discharge of torpedoes, of which she will probably carry over thirty. For surface work, despite the *armour carapace* with which she is credited, and her armament of 140 mil. guns (155 mil. have also been mentioned), she will never be quite capable of meeting small cruisers of corresponding displacement on an equal footing, for her battery, even raised in towers (as in the *X-1*), will be too low, deprived of the necessary command, inferior also for number of guns and rate of fire; and, worse than all, penetrating hits of possibly no great consequence, for an ordinary surface cruiser might be deadly for her, making it impossible for her to seek refuge under water. Still, when everything has been said as to the defects inherent to the large submarine types that have consistently been opposed by Constructor Laubeuf on that very score, the *Surcouf* will be a formidable dreadnought of the sea, endowed with unlimited capabilities for surprise missions, given a fearless and professionally able commander and a well-trained long-service crew, and her career will be watched with interest. Her trials are likely to be protracted to judge from what is taking place at Cherbourg with the *Redoubtable* and *Vengeur,* prototypes of the 1,560-2,080-ton series of *sousmarins de primière* class (of which no fewer than nineteen are ready or building).

It is unnecessary to say, although being named after a famed Breton corsary of the Napoleonic era, the *Surcouf* is not primarily intended for *guerre de course.* Enemy warships are to be her quarry, and she has been built and lightly armored for that. To hold her own in the give-and-take game (like the British *X-1,* her prototype) is her *raison d'être* in the mind of those who designed her. Enemy cruisers bound for French colonies, and escorting troop convoys, might unexpectedly find her across their route, for her surface speed has been designed for that very work, and it is high enough to enable her to catch at sea an enemy convoy. But it is unnecessary to add that if our German neighbors (with whom, happily, friendly relations have been restored) were, as in 1914, to declare war on France, grabbing hold of France's belongings on land, nothing could prevent ships like the *Surcouf* meting out similar treatment to Germany's belongings happening to float on the water. To the simple French mind, property on land and lives on land ought to be just as sacred as property and lives at sea.

Building Program

New York *Times,* November 17.—During the coming year France will build one 10,000-ton cruiser, six destroyers, six first-class submarines, one submarine mine layer, one surface mine layer, two small scout craft, and one net layer, according to provisions of a bill submitted to the Chamber of Deputies by the Ministry of Marine in connection with the budget. This building program will be slightly less than was accomplished during the current year and will be in fulfillment of a building program laid down in 1926.

The cruiser will be of the same type as the *Tourville.* The six destroyers will have a slightly larger displacement than those built formerly.

The building program, by which it is sought to replace the pre-war fleet of 350,000 tons which still is in service and the 50,000 tons recovered from Germany, is six months behind. One of the causes has been the increased cost of building. This year's program will entail an expenditure of 1,267,000,000 francs ($50,680,000), which will be spread out over the years 1930 to 1934.

The net layer is designed to protect ships at anchor close to port waters against submarines. For years French naval authorities have been conducting elaborate experiments in net defense at Toulon, which are said to have proved very satisfactory.

GERMANY

New Cruisers

The Engineer, October 25.—With the launch of the *Leipzig,* which took place at Wilhelmshaven on October 18, all five cruisers of the German replacement program are now afloat. The *Emden* was launched in January, 1925, the *Königsberg* in March, 1927, the *Karlsruhe* in the following August, and the *Köln,* last May. All these ships have the maximum displacement of 6,000 tons sanctioned by the Versailles Treaty. The *Emden* is of what may be termed orthodox design. She has turbines of 45,000 s.h.p. for twenty-nine knots, and is armed with eight 5.9-inch guns, at present mounted singly on the center line and broadside, but eventually to be remounted in pairs on the center line alone. In the *Königsberg* and the other three ships many innovations have been introduced. They have welded hulls, turbine engines of 65,000 to 72,000 s.h.p., and an auxiliary oil engine plant for propulsion at cruising speeds. The *Königsberg* can steam at thirty-two knots, but the *Leipzig,* with increased engine power, is expected to reach thirty-four knots. The three "K" ships and the *Leipzig* have a uniform armament of nine 5.9-inch guns, four 3.4-inch A.A. guns, and twelve torpedo tubes in groups of three. The 5.9-inch guns are in triple turrets, one forward and two aft. Considering the tonnage of the ships, this is an exceptionally powerful armament, while the high speed and wide radius of action are other good points in the design. The stem below water is bulb-shaped, this form of bow being similar to that of the liners *Bremen* and *Europa.* It is said to have a favorable effect on speed, and also to reduce pitching movements, besides providing extra space for the stowage of oil fuel. The power trials of the cruisers so far tested are reported to have been very satisfactory. Germany may justly be proud of her new squadron of five cruisers, the design and workmanship of which appear to be considerably above the average. No further cruisers are projected at present, but a 10,000-ton "armored ship," *Ersatz Preussen,* is on the stocks at Kiel, and it is proposed to build three sister-vessels in due course.

Details of the "Leipzig"

The Engineer, November 15—We are now able to publish more complete data of the *Leipzig,* the fifth and last cruiser of Germany's post-war program, which was launched at Wilhelmshaven on October 18. Although of the same general design, this vessel differs in many important respects from the preceding ships *Königsberg, Karlsruhe,* and *Köln.* She has a length on the water line of 544½ feet, a breadth of fifty-three feet four inches, and at normal displacement, *i.e.,* 6,000 tons, draws fifteen and one-half feet. She is therefore shorter and broader than the earlier cruisers, and has appreciably less draught. Photographs taken at the launch show her to have pronounced bulges, which, besides affording protection against underwater attack, are fitted up as reserve oil bunkers. There are three propeller shafts, the outer two being driven by steam turbines and the middle shaft by an internal combustion plant, which, although installed primarily for cruising purposes, will also be in operation when the ship is running under full power. This plant, built in the M.A.N. shops at Augsburg, is of exceptionally light construction, and is designed to produce 12,000 b.h.p. The turbine machinery, taking steam from six old-burning water-tube boilers, develops 60,000 s.h.p. Consequently, the total output of the propelling machinery is 72,000 h.p., and a speed of thirty-two knots is expected. With the oil engine alone in action the ship will have a speed of eighteen knots and a radius of 2,500 miles. By reducing the speed to fourteen and five-tenths knots the radius would be increased to 3,800 miles. Using the turbine engines alone the ship could steam 3,200 miles. The cruising endurance of the *Leipzig* is, therefore, 7,000 miles. If, however, the emergency side bunkers were full, the ship could cover a considerably greater distance at economical speed. The main armament of nine 6-inch guns is carried in triple turrets on the center line, one forward and two aft. In the *Königsberg* and her two sisters, which have finer lines, the after turrets are *en echelon,* an arrangement necessitated by the limited space available for shell rooms and magazine; but the increase of breadth in the *Leipzig* has made it possible to revert to a center-line disposition. In appearance she

differs markedly from her predecessors. All the boiler uptakes are led into a single but very large funnel casing, which stands well abaft the bridge. The *Leipzig* is of special interest as representing the latest development in German cruiser construction within the displacement limit of 6,000 tons specified by the Versailles Treaty.

CHILE

The "Araucano"

Naval and Military Record.—The ceremony of launching the *Araucano*, the latest addition to Chile's modern fleet, was gracefully performed by Madame Tıla Urrutia de Escobar, the wife of the chief of the Chilean Naval Commission in London, at the Naval Construction Works of Messrs. Vickers-Armstrongs, Ltd., at Barrow-in-Furness, on Tuesday, in the presence of a large and distinguished gathering.

The *Araucano* is being constructed to provide the Chilean Navy with a vessel capable of efficiently maintaining six large submarines of the *Capitan O'Brien* class at sea, and affording that rest and recreation for the officers and crews of the submarines which is so important during prolonged service away from a land base.

The *Araucano* is a steel, single-crew, coal-burning steamer, equal to Lloyd's highest class for foreign-going vessels, and the principal dimensions are as follows: Length, b.p., 390 feet; breadth, moulded, 55 feet; depth, moulded to upper deck, 30 feet 3 inches; mean draft, loaded, 16 feet 6 inches; speed, thirteen knots.

Provision is made for all the necessary services to the submarines, including the supply of fuel, battery charging workshops for running repairs, spare torpedo body and head stowage, and accommodation for their officers and crews. In the double bottom ample capacity is provided for oil fuel and reserve feed water and fresh water. Special attention has been given to the lifting appliances for quickly transferring stores, torpedoes, and spare parts of machinery to and from the submarines when moored alongside the depot ship.

The captain, submarine commanders, and officers are each provided with a comfortably appointed cabin, and bathrooms and lavatories are provided in convenient positions. Separate dining-rooms are arranged for the captain, the commanders, and the officers, with a smokeroom and lecture-room adjacent. These rooms are neatly paneled and comfortably furnished. Accommodation is arranged for sixty-eight sub-officers in four-berth cabins, eighty petty officers in folding bunks, and 386 seamen and stokers, with the necessary bathrooms and lavatories. Ample storerooms are provided for provisions, etc., for prolonged service at sea.

The main propelling machinery consists of one set of Parsons compound turbines, driving the single four-bladed propeller through single reduction helical gearing, with Vickers-Bostock-Bramley "enveloping" tooth. The turbines comprise one impulse reaction high pressure and one all-reaction low pressure, working in series, and driving separate pinions engaging with the main gear wheel. Two astern turbines are fitted, comprising an impulse wheel in the H.P. ahead cylinder, working in series with an impulse reaction turbine embodies in the L.P. ahead cylinder casing. The total shaft horsepower developed is about 2,500, and the astern turbines have about 65 per cent of the full ahead power. Steam is supplied by three single-ended cylindrical boilers, arranged for coal-burning only under Howden's system of hot forced draught. The total heating surface of the boilers is about 7,000 square feet. The condenser, of Weir's regenerative type, is underslung from the L.P. turbines. All the usual auxiliaries, including steam-driven main and auxiliary circulating pumps, air pumps, feed, forced lubrication, and service pumps, are supplied of the latest practice. Two complete sets of evaporating and distilling plants are provided.

The workshops, which are situated forward of the machinery spaces, consist of the following: Heavy machine shop, light machine shop, pattern shop and foundry, carpenters' shop and torpedo and electrical workshop. These workshops are equipped with all the necessary machines, the most efficient of their respective types, and facilities to enable any ordinary repair work to be carried out on board. Suitable stores are provided adjacent to the various shops.

The electrical equipment is comprehensive and in accordance with the latest naval practice. The electrical generating machinery consists of two turbo-dynamos for the

ship's general service and lighting purposes, and two turbo-dynamos for battery charging purposes. The lighting of the officers' cabins, crew's quarters, and workshops has been carefully considered, and special fittings are provided to avoid eye strain. Electric fires are fitted for the comfort of the captain and in the officers' smokeroom.

In addition to the ordinary lighting and power requirements of the ship and submarines, the following facilities are provided, all of the most up-to-date type: Two large and two small searchlights, telephone and bell systems, gyro-compass equipment, electrical rudder indicator, underwater signaling system, echo depth-sounding machine, wireless equipment, and direction-finding equipment.

In the construction of the *Araucano* the builders have had the advantage of their experience in the construction of H.M.S. *Medway* and H.M.S. *Resource*, two vessels of similar type.

MERCHANT MARINE

Optimism in American Shipbuilding

By Homer L. Ferguson, President of the Society and President of the Newport News Shipbuilding and Dry Dock Company, *Nautical Gazette*, November 23.—The history of this society shows many ups and downs. There have been many lean years. Our yards have been struggling along with such coastwise, lake, and river tonnage as has been offered, but it was barely sufficient to keep the proverbial wolf from the door. In fact, several once prosperous yards gave up the struggle and disbanded. We have needed government aid for our merchant marine, such as a number of other countries have had for many years, and now that this is an accomplished fact the outlook for shipbuilding is brighter than it has been for the past decade.

I referred in my address last year to the favorable loan provisions of the Jones-White Act. Since that time we have seen the influence of this act on shipbuilding. The quarter-billion-dollar construction loan fund established by this act has been available for little more than a year, yet the Shipping Board has granted loans for about one-fifth of the fund to rehabilitate our merchant marine by making possible the construction of modern passenger and cargo vessels in American shipyards for overseas trade. The loans granted so far amount to about $50,000,000, and will furnish three-fourths of the construction cost of eighteen ships. These consist mostly of modern, up-to-date, fast passenger and freight vessels. When obscurities in the language of the act relative to mail contracts are straightened out we may expect greater activity in the application for loans.

For the first time since our shipyards were filled to overflowing with the great government shipbuilding program during the war we are able to take an optimistic view of shipbuilding prospects. It is, therefore, very gratifying to be able to record an unusual number of contracts for vessels awarded during the past year. Fifteen passenger and freight vessels have been contracted for along with several freighters, revenue cutters, ferryboats, car ferries and carfloats, besides several hundred barges of various sizes. Americans are turning more and more to the water for pleasure, as is indicated by the contracts for twenty-one large steel yachts awarded in the past year. At the present time there are more than twenty passenger and freight vessels contemplated, besides numerous other smaller craft. Very little oil tanker tonnage has been built since the war, due to the large number constructed at that time by the Shipping Board which have had to be absorbed by the trade, but greater activity has been shown this year. Twenty contracts for tankers, totaling about 200,000 deadweight tons, have already been placed with the various yards, and about 75,000 tons more will probably be placed in the near future. The construction program of the United States Lines is by far the most important ever contemplated in this country. They have already asked for bids for two twenty-two-knot first cabin ships 705 feet long and propose two more of the same type in addition to two superliners to operate in conjunction with the *Leviathan*.

The Naval Disarmament Conference in 1921 limited the size of new fighting ships for a period of years to 10,000 tons displacement, and the new conference about to convene is likely, among other agreements, to limit the number of naval vessels of this and smaller types. In this connection I wish to call your attention to a fact of vital importance to this society, which

is that as the number and size of armed naval vessels is decreased the importance of high-speed merchant shipping is increased. For several years this was apparently given little consideration by this country, as nothing was done by our government to aid our merchant marine until the enactment of the Jones-White Act. Other countries have realized this condition, as is evidenced by the number of high-speed passenger and freight vessels for overseas transportation which they have built. It will probably take many years before we, as a nation, reach a parity in this important respect.

The "Asama Maru"

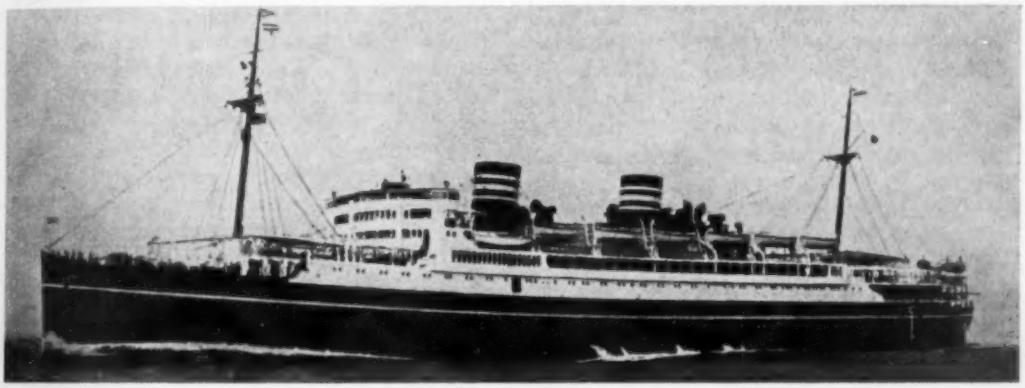
Marine Engineer and Motorship Builder, November.—One of the most important motorships to be completed within recent months is the *Asama Maru,* the first of three large motor liners building in Japan for the San Francisco via Honolulu service of the Nippon Yusen Kaisha. All three vessels, the *Asama Maru, Tatsuta Maru,* and *Chichibu Maru,* are nineteen-knot vessels, the two first mentioned being quadruple-screw Sulzer-engined craft, while the third is propelled by two Burmeister and Wain double-acting four-stroke cycle engines.

The principal particulars of the *Asama Maru,* which has been built by the Mitsubishi Zosen Kaisha, Nagasaki, are as follows:

Length, between perpendiculars, 560 feet.
Beam, moulded, 72 feet.
Depth, moulded, 42 feet, 6 inches.
Deadweight capacity, about, 8,000 tons.
Gross tonnage, about, 16,500 tons.
Service speed, 19 knots.
Total power, about, 15,500 b.h.p.
First-class passengers, 200.
Second-class passengers, 100.
Third-class passengers, 500.

The vessel has three complete decks, and it is worthy of note that all the electrical auxiliaries are of British manufacture. Twelve Laurence Scott five-ton winches and four of three tons capacity are provided. The Wilson windlass is driven by a 140 b.h.p. Laurence Scott motor, and the four fifteen-ton and two five-ton Napier capstans have motors of the same make.

The propelling machinery consists of four eight-cylinder two-stroke cycle single-acting heavy-oil engines of the Sulzer type. Each engine is capable of developing 3,875 b.h.p. at about 115 r.p.m., the cylinders having a diameter of 680 mm. and a piston stroke of 1,000 mm. The machinery has sea water cooled pistons, four motor-driven pumps being provided for this duty and also for circulating through the fresh water coolers —the cylinder jackets are fresh water cooled. Current for driving the scavenging air blowers, deck and engine-room auxiliaries, etc., is provided by four 450 kw. and one 100 kw. Diesel generating sets. Two oil-fired Scotch boilers are provided.



THE *ASAMA MARU*

The trials of the *Asama Maru* were in every way successful, a maximum speed of twenty-one knots being attained.

French Merchant Marine Ministry

Nautical Gazette, November 23.—That questions of maritime policy will receive particular attention from the government and that the development of the merchant marine will be energetically pursued are

shown by the establishment of a Merchant Marine Ministry, which was decided upon by M. Tardieu, the new Premier, when he formed his Cabinet on November 2.

M. Louis Rollin, deputy for Paris, has been placed at the head of this department, which will deal with all matters pertaining to the merchant marine, ports, and fisheries. These services were formerly directed by an under secretary of state, but the post was elminated in 1926 by M. Poincaré for reasons of economy. This solution proved detrimental to the interests of shipping, and the creation of a special department placed under the direct authority of a responsible minister had been urged for some time in Parliamentary circles as well as in shipping circles.

ENGINEERING AND RADIO

The Protection of Boiler Parts by Aluminium

The Shipbuilder, November.—The idea of coating metal subject to corrosion with some other metal which is not affected has been known for some time, and within the past year a new process of "aluminising" has been developed in Germany. One of its most useful applications is the production of heat-resisting coatings for boiler parts which are vitally exposed to the heat of the combustion gases. The process may be applied not only to iron and steel, but to other metals.

The protection is effected by spraying a coat of aluminium on the parts to be treated. A special coating is thus produced, which protects the parts against the influence of the air during the subsequent burning process, in which they are heated to 2,000° F. At this temperature the aluminium actually flows into the iron and the iron into the aluminium, so that a covering of an alloy is formed which has a depth of about 1/40 inches. This alloy, which has a melting point of about 2,200° F., oxidizes when exposed to the influence of heated air, but its oxides have the favorable property that their coefficient of expansion is the same as that of the alloy. There is, therefore, no tendency to form scale which may fall off when exposed to varying temperatures. This behavior is superior to that of iron oxides, which separate from the metal when being cooled down. The oxidation of the alloy surface ceases when this thin cover has been formed.

Extended investigations with aluminised iron and steel parts have proved that their endurance when exposed to the influence of heated gases at a temperature of 2,000° F. is increased ten times when compared with unprotected material; and at a temperature of 1,800° F. this increase amounts to more than twenty times. A special application of the aluminising process is to be found in the parts of boiler superheaters which are exposed on both sides to hot gases, such as the baffles and superheater fastenings.

Investigations were made some years ago at Messrs. Blohm and Voss's yard in Hamburg to select the best heat-resisting materials for such parts, and aluminising most satisfactorily fulfilled the requirements. Later, the fastenings and baffles of the boilers of a 30,000-ton steamship were made of aluminised mild steel; and more recently similar parts of the boiler plants of the *Bremen* and *Europa,* the new Atlantic express liners of the Norddeutscher Lloyd, have been carried out in aluminised material. Altogether in these vessels about 80,000 square feet of boiler materials have been covered by the aluminising process. This process has also been employed on the complete superheaters for a large stationary boiler plant. The aluminised superheater parts of the first vessel in which this new process was employed have given very satisfactory results in two years' practical service.

Trials have been made on the tubes of a large marine water-tube boiler. Three years ago ten aluminised tubes were put into the boiler, and at the same time a number of normal uncovered tubes were renewed. The new uncovered tubes in the lowest row, which were most exposed to the boiler gases, had partly to be renewed after three to four months' service; while the aluminised tubes were, with the exception of one, still satisfactory after three years' service. A careful investigation of the uncovered tubes which failed, showed that they were especially worn on the outside and that their wall thicknesses had been reduced from 4 to 2.5 mm. The wear and tear on the outside had been caused by the thermal, mechanical, and chemical influence of the gases and, as a consequence of this deterioration, the inner steam pressure had deformed the tubes. The scale then broke off, and stresses were set up in the material

which caused corrosion grooves in the inside. This investigation showed that the outside protection of tubes under pressure also delays inner corrosion. The aluminising process applied to water tubes for boilers is, however, more complicated, as the coating must be capable of resisting bending in the cold state. Parts which are aluminised in the normal way will not withstand bending or rolling when cold. To overcome this difficulty, the process has been adopted for spraying the insides of curved tubes.

New Cathode Ray Tube

New York *Times*, November 24.—Television has taken another step nearer the home. The whirling disk heretofore utilized to scan the images has been eliminated from the circuit by Dr. Vladimir Zworykin, who has introduced the cathode ray tube to produce the beams of light that paint the images on the screen. Dr. Zworykin is an engineer associated with the research laboratories of the Westinghouse Electric and Manufacturing Company at Pittsburgh.

He has also dispensed with the neon tube and with all moving parts, thereby simplifying the television receiver, making it foolproof and more practical for use in the home.

Dr. Zworykin asserts that he is ready to discuss:

"the practical possibility of flashing radio images on motion-picture screens so that large audiences can view the television broadcasts of important events as sent out from a central station."

Visual broadcasts in the future will be synchronized with sound. The cathode ray television receiver has no moving parts, making it more easily usable by the rank and file of the radio audience. It is quiet in operation and synchronization of transmitter and receiver is accomplished easily, even when using a single radio channel.

Another advantage is that, using a fluorescent screen, the persistence of the eye's vision is aided and it is possible to reduce the number of pictures shown each second without noticeable flickering. This in turn allows a greater number of scanning lines and results in the picture being produced in greater detail without increasing the width of the radio channel.

The apparatus used for demonstration is not in commercial form. It is an experimental machine from the Westinghouse research laboratories.

The pictures or images formed by the cathode ray device measure about four by five inches. To employ the apparatus successfully for the broadcasting and reception of images Dr. Zworykin found it necessary to develop a new type of cathode ray tube, which is called the "kinescope." A pencil of electrons from the cathode tube bombards a screen of fluorescent material, that is, a substance which becomes brilliant or fluorescent where the electrons strike the material. The pencil of electrons follows the movement of the scanning light beam in the transmitter while its intensity is regulated by the strength of the impulses received from the transmitter. The movements of the scanning beam, consequently of the cathode ray pencil, are so rapid that the eye receives a perfect impression of a continuous miniature motion picture. A reflecting mirror mounted on the receiver permits the picture to be observed by a number of spectators.

The transmitter consists of a motion-picture projector rebuilt so that the film passes the film gate downward at a constant speed. This movement is the vertical component of scanning.

The horizontal scanning is accomplished by sweeping the film crosswise with a point of light at a speed faster than the speed of downward movement, consequently the picture passing through the gate is scanned crosswise and from bottom to top by a series of horizontal lines. The light is supplied by an ordinary automobile bulb focused on a diaphragm. The latter in turn is focused on the film and the light which passes through is again refocused as a stationary spot on the photo cell. In this way the photo-cell current is independent of the surface sensitivity variations of the cell. The horizontal scanning is accomplished by deflecting the light beam by means of a vibrating mirror.

Mr. Zworykin sums up the advantages of the cathode tube in the television receiver as follows: The absence of moving mechanical parts, quietness of operation; simplicity of synchronization even on a single carrier channel; ample amount of light; the persistence of fluorescence of the screen which aids persistence of the vision of the eye and permits reduction of a number of pictures per second without noticeable flickering. This in turn allows a greater number of lines and consequently better details of the picture without increasing the width of the frequency band.

AVIATION

Analysis of Naval Aviation Accidents

The Bureau of Aeronautics, Navy Department, October 23.—The Navy Department has recently completed a study of all accidents occurring in naval aviation during the past eight years, with the idea of learning from the underlying causes of the crashes how best to avoid or reduce repetitions. Two years were required to complete the report, but the result is the most comprehensive and authoritative analysis that has even been prepared on this subject, either in this country or abroad. It brings to light many highly interesting facts and should unquestionably mark a step forward in the crusade for increased safety. Coming, as it does, at the time when the National Advisory Committee for Aeronautics is engaged in its study of methods of reducing accidents in the military and civil branches of aviation, the report would evoke great interest on the part of all those connected with aeronautical activities.

This study of all accidents occurring in naval aviation during the past eight years, incontrovertibly shows that the predominant responsibility for crashes rests on the pilot. This indicates two things: first, that manufacturers must continue to incorporate new elements of safety in their products in order further to reduce the demands made upon the necessarily fallible human element; second, it shows how necessary it is that pilots be selected only from the very best material, and that they be given the most careful and thorough training. That careful supervision be exercised over inexperienced pilots is of paramount necessity, for naval statistics show that the most dangerous period for the flyer is at about his 200-hour mark. It is at this time that he starts his involved maneuvers; he is flushed with over-confidence which far outweighs his experience, and the result is often fatal.

Other interesting facts brought out in the analysis are shown below. In this study, as in all similar work, an aviation accident is defined as an occurrence which takes place while an aircraft is being operated as such, and as a result of which a person or persons are injured or killed, or the aircraft receives appreciable or marked damage through the forces of external contact or through fire.

(1) While the pilot is responsible for less than one-half the non-injury accidents, he is responsible for three-fourths of the fatal ones. This is explained by the fact that an accident may prove unavoidable but the good pilot will avoid serious consequences through his greater skill and ability.

(2) The infrequent flier is the most dangerous pilot. This is an unquestionable fact, of course, but the study even shows that if a pilot quadruples his frequency of flying he will almost halve his accident hazard even though he is in the air four times as much.

(3) The seasoned flier has only one-third as many accidents as the recent graduate from a flying school.

(4) The past records of pilots who eventually have a fatal accident, killing either themselves or others, show that they had almost two and one-half times as many accidents as those who never figured in such catastrophies.

(5) The underlying causes of the mistakes that pilots make indicate that these mistakes too often result from a lack of appreciation of the definite limitations to which they must hold themselves.

(6) The detailed causes of accidents are as follows:

Errors of pilot, 52 per cent.
Power-plant failures, 18 per cent.
Structural failures, 13 per cent.
Condition of airport, 9 per cent.
Weather, 2 per cent.
Supervising personnel, 2 per cent.
Miscellaneous, 4 per cent.

(7) The detailed causes of errors of pilots are as follows:

Faulty flying technique, 63 per cent.
Faulty judgment, 19 per cent.
Carelessness, 14 per cent.
Violation of safety regulations, 4 per cent.

That two-thirds of these errors came under the heading of "faulty technique" is further proof that aircraft still requires too much of the pilot and indicates the necessity of still further improvement in this regard.

(8) The detailed causes of power-plant failures are as follows:

Failures of the fuel system, 48 per cent.
Failures of the ignition system, 13 per cent.

Failures of the lubrication system, 12 per cent.

Failures of the engine structure, 10 per cent.

Failures of the propeller, 6 per cent.

All other causes, 11 per cent.

From this it is evident that the design of aircraft engine fuel systems promises greatest improvement in engine reliability. Stopped strainers, broken gasoline lines, and failures of pumps are the leading causes. Stopped strainers usually represent both faulty maintenance and faulty design. It is an interesting fact to note that during the past eight years naval aviation history shows only one case where a fatal accident was traceable solely to engine failure. In all others at least a portion of the responsibility devolved upon the pilot.

(9) More accidents occur on Thursdays than on any other day of the week. No satisfactory explanation can be given for this fact. Further study is being given to determine the exact reason therefor.

(10) Almost one-half of the fatal accidents which occur come as a result of the dreaded tail spin. Of these almost all (94 per cent) occur without engine failure and the vast majority (80 per cent) from an altitude of 200 feet or less, where insufficient height remains for a proper recovery from this condition. The answer in military aviation where high maneuverability is essential is not immediately apparent. However, it would appear that in commercial aviation, unhampered by this particular requirement, the aircraft of the future must be so designed that it cannot be spun. When this is done, and present development indicates its possibility, fatal accidents will be tremendously reduced.

(11) The safest type of aircraft which the Navy has is the training airplane; while the fighting plane with its high speed and required use of complicated and dangerous missions, such as aerial gunnery and tactical work, stands lowest.

(12) During the period covered by this study, the safety of naval aviation has improved fivefold.

As a result of this study, the Navy Department has published a comprehensive treatise on the whole subject and circularized it to every naval aviator. Further, one naval aviator has been permanently assigned to keep accurate records of all commands and the individual pilots themselves. It will be this officer's duty to keep all of those concerned with the administration of naval aviation constantly informed of the situation as regards aviation safety.

The "ZRS-4"

The Bureau of Aeronautics, Navy Department, October 23.—The actual erection of the first of the Navy's new rigid airships was started at Akron, Ohio, on November 7. Until a name is assigned, this airship is designed *ZRS-4*.

The airship will be inflated with 6,500,000 cubic feet of helium gas which will give a gross lift of 180 tons. When completed the airship will be the largest in existence. The airship itself will weigh ninety-eight tons, leaving eighty-two tons as useful load, to include the crew of about forty-five, provisions, fuel, etc. Translated into speed and distance, the airship can cruise about 2,500 miles at her maximum speed of eighty-four miles per hour or over 10,000 miles at her normal cruising speed of sixty miles per hour.

The design for the airship is well on the road to completion. Production of the girders which comprise the main portion of the airship's structure started several months ago. The large airship shed, which the Goodyear-Zeppelin Corporation has built at Akron, is practically finished and this fact now permits actual erection of the airship to commence. This is the justification for the "ring laying" ceremony at Akron on October 31, analogous to laying the keel of a surface vessel.

The future program in constructing the *ZRS-4* is to erect a complete section of the airship and to subject it to various engineering tests in order to thoroughly prove every feature of the design. These tests will probably be completed in the spring of 1930. Erection of the remainder of the airship will occupy about another year, giving a date of about July, 1931, by which the airship should be ready for flight trials. The second of the two airships, *ZRS-5*, should be completed about the end of 1932.

These airships are intended for operation with the fleet and the expectation is that one will be based on the East Coast and one on the West Coast. When they are available, opportunity will be at hand for the Navy to investigate more completely

than heretofore possible, the capabilities of this type of aircraft for coöperation with surface fleets and with airplanes.

Gyroscopic Control for Aircraft

New York *Times*, November 17, by T. J. C. Martyn.—The recent flight of an airplane piloted automatically by a gyroscope has served to focus anew aeronautical interest on the significance of a device which promises to revolutionize the art of aviation. (See ill. XXXII)

Gyroscopic control is not a new child of applied mechanics. It is in use today over the seven seas. Gyroscopic compasses, far more accurate than their magnetic brothers, attached to automatic steering devices, guide ships over long stretches of water with only infinitesimal error—far more accurately than the hand of man can control the helm. Gyroscopes can ride bicycles more gracefully and more safely than an acrobat. They keep a monorail car perfectly steady on its single rail. And they even can be made to rock a boat to keep it steady in a heavy sea. The gyroscope has been called the most perfect robot.

Neither is the use of gyroscopes in airplanes new. Lawrence Sperry won a prize in a plane fitted with this form of control in 1914. Development was greatly extended during the war, and, in combination with radio control, a plane was semi-successfully taken off the ground and landed without a human being inside. More recently a German made a successful flight from Berlin to Dessau, in which a human pilot touched the controls only in taking off and landing.

The gyroscopic stabilizer, as the latest aëro-gyroscope is called, has brought automatic control to the threshold of practicability—a threshold, be it said, that bids fair to make it an indispensable unit of equipment in all long-distance passenger transport planes. For one thing, it is lighter than any similar device previously built and more compact. It weighs a mere fifty pounds and fits easily under the pilot's seat. The method by which it masters the plane's controls is, too, an important forward step.

Gyroscopes are, perhaps, the most perfect instruments for demonstrating the truth of Newton's famous law of physics that every action has an equal and opposite reaction. If a plane fitted with a gyroscopic stabilizer turns of its own volition to the right, the horizontal wheel immediately tends to assume a vertical position directly equal and opposite to the degree of the turn, although to the naked eye it does not appear so. The force thus set up actuates the rudder through an electro-magnetic medium, and the plane is brought back to its original course, not even a split fraction of a degree off it. Similarly, if the plane attempts to drop its nose, the vertical gyroscope attempts to achieve a horizontal position and the force is directed to the elevator to bring it back to a level keel.

Thus physicists say that a gyroscope utilizes the force of gravitational pull. They prove that it does, but they do not know why. Neither does any one else. And all a gyroscope is, as any one who has played with a toy one knows, is a wheel spinning at a high velocity and attached to an axis which is free to move in any direction. In the Sperry gyroscopic stabilizer there are two wheels, electrically operated, and each one is free to move in only one direction, horizontal or vertical. This insures perfect stability except for atmospheric drift, which must be checked up by a human operator.

To fly through fog is now quite possible without the use of a gyroscope. Lindbergh flew to Paris across the Atlantic without sometimes seeing a fixed point for considerable periods. More recently Doolittle flew "blind" in a plane and took off in it, steered a round course and landed it again. This kind of flying is done entirely by instruments supplemented by radio control. At best it is exhaustive and often it is far from accurate.

Even flying across country in the daytime in good or fairly good weather, there is a strain put upon the pilot that must always tend to make him less efficient. Cross-country flying is likely to be tedious at best, even though the pilot's attention is divided among innumerable cares. He has no time to spend—or certainly not enough of it—on avigation. This is why a second pilot or navigation officer is carried on almost all big planes. But with a gyroscope control is maintained automatically over the three axes about which a plane moves.

A gyroscopically controlled plane is armed against fog, gusts of wind, mist, snow, sleet and all the rest of the many factors that plague the avigator. It is also

independent of the sun, moon, stars, earth, etc. Once the plane has been set on a given course and the gyroscopic stabilizer has been set to guide it on that course, not all the elements nor all the errors of men can combine to persuade it off that course, provided that the instrument is let alone. There is one exception and that is the wind. A steady wind carries a plane, no matter in what direction it is traveling, in its own direction.

That is what is meant by atmospheric drift. A plane may fly due west on a course that would normally take it to Chicago. But if the atmospheric drift were from north to south, the plane might conceivably end its flight at St. Louis, despite the fact that the course was due west. The drift would then have caused the whole body of the plane to move through the air, while the gyroscopic control kept the plane on its original compass course. To counteract this the avigator has constantly to check up on his drift and make the necessary corrections on the gyroscopic stabilizer.

True, there is room for human error to creep in. Time and wind direction have to be calculated by the human pilot or navigator. But with radio connection it should not be difficult to keep track of the wind speed and elapsed time of flight and, by triangulation, to check up on position, so that even in the densest fog a plane might be steered accurately above any given city. Perhaps the day will dawn when this stabilizer will be attached to a gyroscopic compass.

Development of Echo Altimeter

Aviation, October 26.—A sound wave frequency analyzer has been perfected by Professor Leo P. Delsasso, of the University of California at Los Angeles, for the purpose of analyzing the various sounds emanating from aircraft. Using this instrument, Professor Delsasso has made hundreds of test flights in all types of aircraft and has succeeded in charting all the noises common to modern aircraft. Now it is hoped that some sound wave may be found which will satisfactorily originate from an instrument on an airplane, travel to the nearest earth or solid obstruction, and echo back to an instrument in the pilot's cockpit in order to register the true distance from ground or obstructions. The Guggenheim Fund for the Promotion of Aëronautics has granted Professor Delsasso $2,000 to help develop an instrument of this type. Professor Delsasso is the inventor of the ocean depth sounding device now commonly used by the United States Navy. He seeks to adapt the same fundamental principles of his nautical instrument to the needs of avigation.

Instruments Used in Fog Flying Experiments

Aviation, October 12.—A glance into the cockpit of Lieutenant Doolittle's Consolidated training plane is afforded in the photograph below, which shows the instruments used by the Army flier in his recent blind

FOG FLYING INSTRUMENTS

flying test in which fog landings and takeoffs were simulated. Beside the standard Pioneer panel, the four special instruments are shown as follows: 1—visual radio beacon, 2—Sperry gyroscopic artificial horizon, 3—Kollsman sensitive altimeter recording height above the earth within a dozen feet, and 4—extremely sensitive directional gyroscope.

The Clerget Diesel Aero Engine

Aviation, November 2.—The new heavy-oil aëro engine recently produced by M. Clerget now has been flight-tested successfully. It is a 80-100 horsepower nine-cylinder air-cooled static radial. Its sponsor chose such a low power because he considered it urgent to provide school planes with an engine less liable to catch fire than the ordinary gasoline power plant. But the problem was much more difficult than is the

case with engines of greater power. The engine represents seven years of research and experiment.

The Clerget is a four-stroke engine following the constant-volume cycle with a compression ratio high enough to provide self-ignition. One of the main difficulties encountered was to produce sufficient fuel atomization in the extremely short space of time devoted for the burning of each charge. Each cylinder possesses its independent fuel pump and atomizer, as well as a valve for pure air admission and another for exhaust. The valves are actuated by push-rods and rockers; in fact, the new Clerget static heavy-oil engine possesses an extraordinarily marked similarity to the pre-war rotary gasoline engines of the same make. Externally, the chief difference is the absence of spark plugs and inlet pipes. The new engine is really an assembly of nine independent cylinders around a common crankcase, as each cylinder operates quite independently of the others.

Despite a practically all-steel construction, the weight of the first experimental engine is not as large as might be supposed, taking into account the low power; it actually weighs little more than 4.5 pounds per horsepower, a result never achieved before for a heavy-oil engine of less than 100 horsepower.

The fuel used is ordinary gas-oil; there is no compressing-air device of any kind. The engine starts from cold with surprising ease by means of a mechanical starter. As regards flexibility, it is extremely good; its response to the lever (which acts on the fuel pumps control, of course) is remarkable at every speed from idling to maximum revolutions. The first engine is now engaged in exhaustive endurance tests.

Helium Production at Amarillo

Aviation, November 2—An average purity of 97.7 per cent was maintained in the production of helium at the Amarillo, Texas, plant during September, figures released by the United States Bureau of Commerce show. Of 847,840 cubic feet of gas obtained, 828,700 cubic feet were helium, or "contained helium," as the pure product is called.

This plant, run by the government, showed operating costs of $14,609.31 for the month, or $17.63 per 1,000 cubic feet. The sale of the residue gas not kept by the Bureau of Mines amounted to $3,000.79, which amount will be returned to the United States Treasury from whence comes the money to operate the plant and gas field. Deducting this money from the expenditures for September reduces the production cost of the gas to $14.01 per 1,000 cubic feet of "contained helium."

The September report confines the statements made by the Bureau of Mines before the Amarillo plant was built, to the effect that its operating costs would be much lower than those which prevailed at the government's Fort Worth helium plant. The Fort Worth plant formerly supplied helium used by the Army and Navy but was closed in January, 1929, because of exhaustion of the gas field on which it depended for its helium-bearing natural gas. During the six months ending in December, 1925, when the Fort Worth plant was producing at the rate of 830,000 cubic feet of helium per month, or approximately the same rate as the production from the Amarillo plant in September, 1929, the average operating costs were about $28,800 per month, or $34.70 per 1,000 cubic feet of contained helium produced. During the last six months of the operation of the Fort Worth plant, when the average production was only 407,000 cubic feet per month because of the approaching exhaustion of the plant's supply of raw material, the average monthly operating costs were reduced to about $19,600 but the cost per unit of product rose to about $48.00 per 1,000 cubic feet of contained helium. At the Fort Worth plant, the residue gas did not belong to the government; therefore, no return from it was received.

Although the average purity of 97.7 per cent shown by the September report is lower than purities that will be attained after the Amarillo plant is more completely adjusted, it is a marked improvement over the purity of the helium that was produced at Fort Worth. The average purity of the Fort Worth product was 94.6 per cent in 1926, 95.0 per cent in 1927 and 95.4 per cent in 1928. The highest monthly average purity recorded at the Fort Worth plant was 96.6 per cent in December, 1928.

Construction of the Amarillo Helium Plant was started about August 1, 1928. Operation of the machinery for testing and adjustments was commenced in January,

1929, and production of helium was started in April. Since April, the rate of production, purity of product and operating efficiency have increased steadily. Further improvements in purity and efficiency, and a further lowering of operating costs, are expected in the future.

Flying Boats and the Navy

The Army, Navy and Air Force Gazette, November 7.—Admiral Sir Richard Phillimore, in the course of a letter to *The Times* on "Naval Policy," observes that "the flying boats, which will be the light cruisers of tomorrow, and whose work today is purely naval, do not belong to His Majesty's Navy. How can this anomaly be explained or defended?" The Admiral comes of an old naval family, and is steeped in our sea traditions, so that it is natural he should regard as an anomaly what is accepted as the legitimate order of things by the powers that be. His question is really only a part of the larger question why any aircraft for naval or military purposes should be organized by a separate Ministry. This has been discussed and rediscussed times out of number since the Royal Air Force was separated from the Navy and Army in 1918, but the principle of a single Air Service has always been upheld. In 1923, when a sub-committee consisting of Lord Balfour, Lord Peel and Lord Weir considered the question of the control of Fleet air work, they recommended certain changes in the former system, but "they did not think it possible to sever complete the Air organization which does work for the Fleet from the Air organization responsible for Home Defense against attack, and for coöperating with the Army." It was at this time that there came into being the Fleet Air Arm, under Admiralty control, in which the Navy provides 70 per cent of the pilots and 100 per cent of the observers. The flying boats, which have been developed since then, have nothing to do with the Fleet Air Arm because they do not operate from aircraft-carriers but from shore bases. They are *air* craft primarily and only *sea* craft incidentally; that is, they must be regarded as flying units rather than as boats, so that their work is not altogether "purely naval." But though the flying boat squadrons do not come under the Admiralty, they are, as the official *Navy List* shows, reckoned among the R.A.F. units for naval coöperation and training.

The State and the Schneider Trophy

The Army, Navy and Air Force Gazette, November 7.—When the late M. Jacques Schneider first presented the trophy for international competition, he wished to assist in the development of an efficient seaplane which should be seaworthy as well as airworthy. The development of landplanes has always been in advance of that of seaplanes and M. Schneider felt that the latter needed special encouragement. The rules for the contest were prepared with care, but they were not sufficiently comprehensive to prevent the contest developing into a race in which high speed was the first essential. Thus in the passage of the years the contest has served to produce racing machines which are useless for any other purpose. That line of development would have been harmless were it not for the vast expenditure of time and money which has been necessary in the case of the post-war contests. The government has paid the bill and has supplied the skilled pilots who have flown to victory. That bill was quite large enough to alarm the economists, but, in addition, there must be taken into account the general disturbance of normal work which preparation for the race has produced in the Air Ministry. For months before the last contests certain departments of the Air Ministry devoted the major part of their time to matters connected with the race. Some officials were expected to devote themselves to Schneider Trophy work, but many others, inspired with enthusiasm, were diverted from their proper avocations. Thus the Schneider Trophy contest was expensive in official time.

Similar disturbance was caused in the factories of the firms constructing the airplanes, engines, and accessories of the machines entered. The benefit of all this activity is that the British aircraft industry has produced the fastest seaplanes in the world. Much has been learned during the contests which is of value.

The state has little money to spare in these post-war days and the Air Ministry is as much affected by the need for strict economy as is any other department. The Royal Air Force is in its infancy. It is developing swiftly, but not swiftly enough to satisfy its friends. It needs more squad-

rons, and before it can expand in strength it must have more stations to accommodate its new units. Stations cost money and much of it. The number of mechanics must be increased to cope with the extra work consequent on the formation of new units. This increase also means expenditure of money and time. If the money devoted to the Schneider Trophy contest were allocated to building and to aircraft construction the progress of the Royal Air Force would be accelerated. An extension of orders in the aircraft industry would not only assist the Royal Air Force directly but would give aircraft firms the funds with which to continue the development of aircraft and of engines. The aircraft industry should be a rich industry. It is not rich in these present times and a steady flow of orders is more valuable than is spasmodic spending on the production of racing machines—when that money comes from the government and must of necessity reduce the amount available for normal development.

There is no need to abandon for the future all attempts to win the Schneider Trophy. The government may have a restricted purse, but there are many rich men in the country. Great Britian produces the finest racing yachts in the world, its racing motor cars are in the first class, and its race horses are unequaled. In these matters progress has been due entirely to private enterprise and private expenditure. If one or two rich men desire fame they should order racing aircraft and enter them individually for great events, such as the Schneider Trophy. Such events would retain all their sporting virtues and the Schneider Trophy might cease to be a kind of private war between civilized nations.

MISCELLANEOUS

Hurdles For Five-Power Naval Conference

By Raymond Leslie Buell, Research Director, Foreign Policy Association, in New York *Times,* December 1.—

On January 21 a naval conference is scheduled to open in London which may prove to be of historic importance. Foreign offices and admiralties of five governments are now intensively studying the problems that will come before it in the hope of preventing a repetition of the Geneva fiasco of 1927. If the conference fails, it will not be because of lack of preparation.

The importance which President Hoover attaches to the forthcoming conference is shown by the size and caliber of the American delegation, the members of which were announced on November 20. The American delegation will be headed by Secretary of State Stimson. The other members are Secretary of the Navy Adams, Ambassadors Dawes, Gibson, and Morrow, and Senators Robinson and Reed. It is significant that all of the seven American delegates are civilians. The two encouraging developments, so far, are that France and Italy, both of whom declined to go to the Coolidge conference in 1927, have agreed to go to London, and that the negotiations between Britain and the United States, culminating in the visit of Prime Minister MacDonald to America, have nearly removed past differences over the cruiser question.

Nevertheless, uncertainty exists in many circles as to the outcome of the London Conference. The Washington Conference of 1921-22, which lasted almost four months, nearly foundered over the comparatively simple matters of battleships and aircraft carriers. The forthcoming conference is to tackle infinitely more complicated questions connected with various types of cruisers, destroyers and submarines. In the background will hover explosive political questions, involving naval bases, merchant shipping, freedom of the seas, and the relationship of the United States to the League of Nations. Little wonder that some prophets believe that, despite the elaborate conversations now in progress, the London Conference will last four or five months.

In reality two conferences are to be held in London this January. The first conference meets in accordance with Article XXI of the Washington Treaty of 1922, which provided that in eight years a conference should be held to determine what changes in battleship construction should be made in the light of "possible technical and scientific developments." Under the Washington Treaty battleship replacements should start after 1931.

At present it costs about $37,000,000 to build a battleship, and as the Washington Treaty calls for the construction of fifteen such battleships each by the British Empire and the United States during the next few

years, the financial burden imposed is heavy. All five governments appear to agree that steps should be taken to postpone construction of these costly vessels, or to reduce their size.

The real difficulties arise in connection with the second London Conference, whose purpose is to limit cruisers, destroyers, and submarines. In view of these difficulties, some observers hope that the matter of battleship replacement will be the last rather than the first matter to be discussed at London, in order to hold France and Italy in the conference until the end.

The four difficulties which have loomed upon the naval horizon are as follows: The Anglo-American difficulty over parity in auxiliary craft; the Japanese demand for a ratio of 70 per cent; the relation of the French to the Italian Navy; the relation of France to the naval question as a whole.

Thanks to the negotiations between Ambassador Dawes and the British government, the cruiser difficulty between the United States and the British Empire, which wrecked the Geneva Conference, is on the way to being solved. Both governments have accepted the principle of parity for every type of craft. What is of more importance, both governments seem to have worked out an acceptable definition of parity. Both governments agree that destroyers should be limited upon a basis of tonnage equality; both governments wish to bring about the abolition of the submarine.

So far as cruisers are concerned, both governments frankly recognize that their needs are different. It has therefore been agreed that the British Navy may possess a larger number of cruisers than the United States, but that the United States should have the right to maintain more 10,000-ton 8-inch gun cruisers than the British Empire. While uncertainty still exists as to the actual demands of the United States, it seems that the British desire to maintain a fleet of fifty cruisers of 339,000 tons, while the Americans wish a fleet of thirty-six cruisers having 315,000 tons. The United States, however, desires to maintain six more large cruisers than the British; the British desire to grant the United States a superiority of only three.

This is the one technical difference which now separates the two governments. It should be pointed out, however, that the Anglo-American settlement merely provides for the stabilizing of the British cruiser fleet at its present strength, rather than for any substantial reduction; and for the construction by the United States of from thirteen to eighteen new cruisers.

The failure of the United States and Great Britain to bring about any cruiser reduction naturally has stiffened the demands of other powers. And it is not certain, moreover, that the difference over the three large cruisers can be easily settled. Nevertheless, the success of the conference is of such great personal importance to President Hoover and Prime Minister MacDonald that it is inconceivable that this Anglo-American gap will not be bridged.

The second main difficulty concerns the Japanese demands. It is the policy of Japan to maintain a navy strong enough to prevent outside interference with her communications with the Asiatic mainland, upon which the food supply of Japan depends. About two-thirds of the destroyers and submarines in the Japanese Navy are too small to cross the Pacific. Japanese declare that the Japanese Navy has been constructed only with a view to maintaining control over the China and Yellow Seas. In order to insure such control the Japanese refuse to sign any naval treaty which does not allow them to maintain an auxiliary fleet of a ratio of 70 per cent to Great Britain or the United States.

While it is true that Japan accepted a 60 per cent ratio in battleships at the Washington Conference, this was only after the other governments had given Japan compensation in the form of a promise not to increase fortifications in the naval bases of the Pacific. Japan contends that a 10 per cent increase over the Washington ratio is too small to make the Japanese Navy a menace to the United States and the British Empire, but that it is large enough to remove the feeling of uncertainty as to the ability of the Japanese fleet to protect Japan from outside attack.

Since the Washington Conference of 1922 a number of events have occurred which have strengthened the attitude of Japan. First, the large 10,000-ton cruisers have come into existence; these cruisers are more of a potential menace to Japan than were the cruisers in existence in 1922. Second, the British Empire has begun the construction of the Singapore naval base, which can

be aimed only at Japan. While on November 14 it was announced that the Labor Government would slow down work on this base, construction had already gone to the point where it had seriously aroused the Japanese people.

In the third place, the passage by the American Congress of the Japanese exclusion act of 1924 has not improved relations between the United States and Japan. Perhaps the strongest of all reasons why Japan may be expected to stand firm upon the 70 per cent ratio is because there does not seem to be any compensation which other powers may grant Japan in return for a reduction in the proposed ratio.

Until recently it was assumed that the Japanese merely demanded 70 per cent of the total auxiliary craft in the British and American Navies. But according to a dispatch from Tokio of November 4 the Japanese declare that they must have seven 10,000-ton cruisers for every ten in the American Navy, and that they wish the British and the Americans to reduce the number of such cruisers so as to give Japan this 70 per cent ratio without necessitating new Japanese construction. Now, upon the completion of its present cruiser program the United States will have twenty-one large cruisers. As 70 per cent of this number is about fifteen, it is seven more than the present number of 10,000-ton cruisers in the Japanese Navy.

As a result of the Anglo-American discussions it is probable that the British Empire will maintain only 70 per cent as many 10,000-ton cruisers as the United States. The Japanese demand for a ratio of 70 per cent to the United States therefore means a demand for equality in large cruisers with the British Empire. Consequently, it is not surprising to read that Prime Minister MacDonald has rejected the Japanese plea.

If the Japanese would limit their demands to 70 per cent of the total auxiliary tonnage of the United States, it is possible that the request might be granted. The chief difficulty here is Australia and New Zealand. Nevertheless, the Japanese apparently believe that sooner or later the British and American governments will make concessions, simply because it is essential to the success of the London conference that the Anglo-Saxon powers win Japanese support.

Important as are these Anglo-American and Japanese difficulties, they pale into insignificance in comparison with the problem raised by the relation of the French to the Italian Navy. In a note of October, 1928, the Italian government declared that it was willing to accept any reduction in armaments, however low such reduction might be, provided its Navy was not exceeded by that of any other continental European power. In other words, Italy demands parity with France.

Although France accepted parity in battleships with Italy at the Washington Conference, she now firmly declines to accept such parity in the case of auxiliary craft. Frenchmen point out that the interests of Italy are concentrated in the Mediterranean; but France not only must defend important interests in this area but must also safeguard its Atlantic coast, and possessions in tropical Africa, and in the Orient. To the French, naval equality with Italy would mean actual French inferiority.

These difficulties over the naval question are intensified by the existence of serious political disputes between France and Italy. The first dispute has arisen out of the activities of Italian *émigrés* in France. Many of these *émigrés* have been driven out of Italy by the Mussolini régime and have found refuge in France in accordance with the customs of asylum. Some *émigrés* have abused this hospitality by plotting against the Fascist régime. And the Fascist press has been inclined to hold France responsible.

The latest incident was the attempted assassination in Brussels of the Italian Prince Humbert by an Italian student who had been living in Paris. This attack was denounced by the Italian paper, *Giornale d'Italia,* on the ground that it emanated from an anti-Fascist organization in France whose activities were protected by the French government. France replies that while she makes every effort to prevent the organization of conspiracies, she cannot expel every Italian in France simply to please the Mussolini government.

Difficulties also have arisen over the Italian demand for colonies. Italy is confronted with a serious over-population problem. Italy under Fascism, at least, is extremely nationalistic, and discourages emigration to foreign countries. Instead, Fascism demands more territory under the Italian flag

for its surplus population. The feelings of Italy on this subject are intensified by the fact that its present colonial empire is insignificant, in contrast with the vast empires of France and of Great Britain.

The Italian colonial campaign can succeed only at the expense of France. But France has no intention of making any important colonial concessions, and she does not intend to consider Italian naval demands in the Mediterranean until this feeling of colonial insecurity is removed. Although France has no allies having navies, Italy entered into an understanding with Spain in 1926 and with Turkey in 1928, which French strategists believe place the navies of these two latter powers at the disposition of Italy. The possibility of such alliances is another obstacle to a naval accord between France and Italy.

Nevertheless, at least three proposals have been made to compromise Italy's demand for naval parity with France. First, it is suggested that especially in view of a difficult financial situation, Italy, in return for a declaration of theoretical equality between Italy and France embodying the formula of *chiffres de prestige*, would undertake not to increase its Navy beyond its present size. Second, it is proposed that in the event of failure to reach a concrete settlement, France and Italy agree to the suspension of naval construction for a term of years.

Third, a Mediterranean Locarno has been proposed, whereby France and Italy should agree to parity in the Mediterranean, but France should be allowed to maintain an additional fleet in Atlantic or in Asiatic waters, and Great Britain should guarantee that this additional fleet should not enter the Mediterranean. While Britain is in a strong position to enforce such a guarantee because of its strategic position at Gibraltar, Malta, and Suez, doubts have been expressed as to the willingness of the present Labor government to contract this type of engagement.

That both the French and Italian governments realize the necessity of settling their differences is evident from the events of the last few weeks. Immediately upon its receipt of the British invitation of October 6, the Italian government suggested to France the desirability of conversations. The French press also is pleading for a French-Italian *rapprochement*, so as to present a united front at London against the Anglo-Saxon powers. Although the relations between Italy and the Baldwin government were cordial, the MacDonald régime is viewed with coolness if not hostility by the Fascisti. The common dislike of France and Italy for the British Labor government may bring France and Italy together.

The final difficulty, and perhaps the greatest of all, is the French attitude toward the whole naval settlement as proposed by Great Britain and the United States. At the Washington Conference of 1922, France accepted the ratio of 1.67 to 5 in the case of battleships. Nevertheless, French sentiment seems to be unanimous in the belief that Britain and the United States unfairly jockeyed France into accepting this ratio; and France is determined that it shall not be applied in connection with auxiliary craft.

France has the second largest colonial empire of the world. She depends upon this empire not only for raw materials but also for troops. She does not intend that this empire shall be exposed to attack by a hostile naval force. So far as battleships are concerned, France cannot, for financial reasons, hope to equal the British fleet, but she wishes to offset this inferiority by a large submarine and destroyer tonnage.

The French naval program calls for a cruiser strength of 210,000 tons, which is about two-thirds of the proposed cruiser tonnage for the American Navy; it also calls for 180,000 tons of destroyers and for 96,000 tons of large submarines and about 35,000 tons of small coastal submarines. When this submarine program is completed, France will have many more submarines than any other navy in the world. It is certain that France will not accept the 1.67 ratio in regard to auxiliary craft, but will insist on the right to maintain a cruiser and submarine fleet which will to a certain extent be able to offset Anglo-Saxon predominance in capital vessels. Present French policy is to build four large submarines for every British battleship.

It is certain that France will not agree to the abolition of the submarine, and in this position she will probably be supported by Italy and Japan. It is equally certain that France will demand equality with Great Britain in submarines, while France may even refuse to entertain any proposal to limit small coastal submarines.

Remembering the attacks of the German

submarines during the World War, it will be difficult for Britain to accord parity to France in submarines without an agreement whereby France would promise not to use such submarines against commercial vessels. But the French government has declined to ratify the convention to this effect drawn up at the Washington Conference. In view of the strained relations between England and France since The Hague reparation conference, and of the French belief that the United States is attempting to wean Britain from the Continent of Europe and from the League of Nations, it may prove extremely difficult to work out a submarine formula which will satisfy both the French and the British governments.

In order to prevent a naval settlement at London contrary to her wishes, France has so far insisted upon regarding the forthcoming conference as merely preliminary to a general disarmament conference to be held at Geneva, where land and naval armaments will be jointly discussed. There are two reasons for this position. At London, France will be in a minority against the Anglo-Saxon powers. At Geneva, France will be backed by her allies of Central Europe and by other governments fearful of the Anglo-Saxon naval supremacy. The second reason is that France wishes to bargain her present military supremacy against the naval supremacy of Britain and the United States, and this can only be done in case land and naval armaments are treated together.

In case France and Italy decline to sign a naval agreement in London, but insist on throwing the question back to the League, it is proposed that Britain, the United States, and Japan enter into a tripartite naval agreement, with the proviso that in case any outside power increases its navy the parties to the agreement may increase theirs in proportion.

While such an agreement would bring an end to naval rivalry between Britain and the United States, the French undoubtedly would regard it as final proof that these two powers have determined to cut loose from Europe. If Britain and the United States unnecessarily antagonize France at the London Conference and enter into a separate naval agreement, France in return may refuse to disarm upon land—and land disarmament is even more necessary than naval disarmament if peace is to be realized.

Apparently realizing that an Anglo-American threat against France will do more harm than good, Under-Secretary of State Cotton declared to the press on November 15 that the London Conference would lead to a five-power agreement or to no agreement at all.

Nevertheless, the most serious danger confronting the London Conference is that it may lead to the establishment of two conflicting systems: Anglo-Saxon supremacy upon sea, and military dominance of France and her allies over the Continent of Europe. If these two conflicting systems come into existence, all hope for real disarmament and security will give way to a new set of suspicions.

The real task of the delegates of the forthcoming conference is to bridge the gap between the French and the Anglo-Saxon points of view. It is not impossible that this bridge will be found in the League of Nations. The Continent of Europe no longer expects the United States to join the League. Nevertheless, the whole attitude of Continental Europe toward the United States and the disarmament problem would be changed if the United States would give some indication of its willingness to coöperate with the League Council in the conciliation of disputes which threaten to lead to war, and thus bring moral aid to the quest for security. In the last analysis the success of the London Conference may depend upon a revision of the political attitude of the United States toward Europe.

Deepest Ocean Sounding

Tycos, October.—The deepest ocean sounding ever made is that of 34,210 feet, recently reported by the German Navy Department as having been made near the Philippine Islands by the German cruiser *Emden.* This is a depth of nearly six and one-half miles, or nearly a mile greater than the height of Mount Everest, tallest peak in the world. This means that the known range of variation in the level of the earth's crust, from the greatest height above sea level to the greatest depth below, is 63,351 feet, or approximately twelve miles.

NOTES ON INTERNATIONAL AFFAIRS

From November 4 to December 3

Prepared by Professor Allan Westcott, U. S. Naval Academy

LONDON NAVAL CONFERENCE

American Delegates.—The American delegates to the London Naval Conference scheduled to open on January 21 were announced on November 20 as follows: Secretary of State Henry L. Stimson, Secretary of the Navy Charles Francis Adams, Senators Joseph T. Robinson of Arkansas and David A. Reed of Pennsylvania, and Ambassadors Charles G. Dawes, Hugh Gibson, and Dwight L. Morrow. The expansion of the delegation to seven members by the inclusion of Secretary of the Navy Adams and Ambassador Morrow was unexpected, and was taken as a recognition of the argument that the naval point of view should be more adequately represented. Admiral Hilary P. Jones and Admiral William V. Pratt will accompany the delegation as technical advisers.

Aims of France and Japan.—Discussion in the months immediately preceding the London Naval Conference concerned itself chiefly with the positions that would be taken by Japan, France, and Italy. Japan named a delegation fully versed in naval affairs, and made it clear from the beginning that she would expect a 7-10 instead of 6-10 ratio for the cruiser class as a whole, and would decline any reduction in submarine tonnage. The instructions to the delegation, which is headed by ex-Premier Wakatsuki, suggested reduction of battleship tonnage to 25,000 tons, aircraft carrier tonnage to 15,000 or 20,000 tons, gun calibers to 14-inch, and extension of age limits for all types. The Japanese delegation planned to reach Washington on December 17 for conferences before going to London.

The French policy, as well known, insists on retention of the submarine, and opposes a ratio as low as 1.75-5 for cruisers and other smaller categories, in view of the two coast lines of France and her extensive colonial interests. She would have no objection to the abolition of the battleship. In general the French position is opposed to parity and ratios, on the ground that a nation's navy should be determined by her individual needs, and that construction beyond these needs would be an open manifestation of aggressive policies. She objects also to Britain's maintaining a cruiser force in the Mediterranean equal to that of France and Italy combined. In fact the success of the conference will depend in no small measure on solution of the naval problem in the Mediterranean. (See more detailed account of problems before the Naval Conference in "Professional Notes.")

Immunity of Food Ships.—Speaking before the American Legion on Armistice Day in Washington, President Hoover "put forward an idea" which, though avowedly not presented as a "governmental proposition," aroused much comment at home and abroad. This was that "food ships should be made free of interference in time of war," on the ground that "protection of overseas or imported supplies has been one of the most impelling causes of increasing naval armaments," and that "we should remove starvation of women and children from the weapons of warfare."

This proposal was generally condemned in the French press as conflicting with the League idea of economic blockade, and as encouraging aggressive warfare rather than

the opposite. Feeding the civilian population, it was believed, could not be separated from feeding the armies in the field.

In reply to an interpolation in Parliament, Mr. MacDonald gave assurances that neither immunity of food ships nor other phases of commerce control in wartime would be discussed at the London Conference. Incidentally, assurance was also given that there would be no discussion of abandoning British naval bases in the West Indies and Western Atlantic.

FAR EAST

SOVIET SUCCESS IN MANCHURIA.—With the close of November came a complete breakdown of Chinese resistance to Soviet forces in Northern Manchuria. After contenting itself with raids and forays through the summer and early fall, Moscow apparently decided that the approach of winter and the civil war in central China made it an opportune time to back diplomacy by force. Four divisions were moved, two from the east and two from the west, into Manchuria along the line of the Chinese Eastern Railway. The western force captured Hailar, inflicting about 12,000 Chinese casualties according to reports, and took control of all territory west of the Kinghan Mountains. The eastern force advanced and even threatened the capture of Harbin. By November 26 Chinese resistance was at an end and the Manchurian Government made definite peace promises which included: (1) restoration of the *status quo* on the railway in accordance with the agreement of 1924; (2) reinstatement of Soviet officials; (3) release of arrested Soviet citizens. Though many hitches were expected in the execution of this program, and some of these developed at once, it appeared clear that the Soviet Government would have little further difficulty in securing its aims.

APPEALS TO LEAGUE AND KELLOGG PACT.—On November 26, while the Manchurian leaders were coming to terms with Moscow, the Chinese Government at Nanking addressed an appeal both to the League of Nations and to the signatories of the Kellogg Peace Treaty to take steps to halt the Soviet invasion of Chinese territory. Action on the part of the League was rendered difficult by the fact that Russia was not a member. Both China and the Soviet Republic, however, are signatories of the Anti-War Pact. Through its ambassadors in London, Paris, Rome, Berlin, and Tokio the United States Government made an endeavor to consult as to what action should be taken, and Secretary Lansing finally sent to both nations a reminder of their obligations under the Kellogg Pact.

There were some ironic comments in the press on the fact that war had actually been going on in Manchuria for the preceding three months or more, and the only efforts to stop it by peace machinery were made after the war was over. The absence of sanctions for the Kellogg treaty was also the subject of adverse comment. In a dispatch of November 27 from London to the New York *Times*, Edwin L. James remarked that "almost at the some hour that former Secretary of State Kellogg was explaining to a peace meeting held in one of the halls of the House of Commons this afternoon that the Anti-War Pact was the cornerstone on which the continuing of the peace of the world could be built, Foreign Secretary Henderson was explaining that ....the Kellogg Pact provided no machinery for dealing with infractions of it."

TRUCE IN CHINESE CIVIL WAR.—Coincident with the Soviet success in Manchuria came a sudden halt to the revolt in Central China. That this was in any way a manifestation of national solidarity was quite generally doubted, and in Shanghai there was a commonly accepted rumor that General Yen, the shrewdly neutral governor of Shansi, had accpted $7,000,000, and Marshal Feng Yu-hsiang $3,000,000, for peace without victory. Actual military events in the war area were indecisive, but President Chiang Kai-shek was able to return from the front to Nanking on November 22 with assurances that the revolt was over.

REBELS THREATEN CANTON.—The truce in Central China enabled the Nanking Government to hasten the dispatch of troops by land and sea to Canton, which was threatened by the southward march of General Chang Fa-kwei's "Ironsides" and other rebel forces. It appeared certain that Nanking would be able to handle this situation unless there was treachery on the part of the

army leaders in control of the Canton garrison, before the arrival of reëforcements.

REPARATIONS PROBELMS

WORLD BANK ARRANGEMENTS. — The committee of financiers engaged in organizing the Bank of International Settlement surmounted one of their chief obstacles when in the second week of November they decided that the city of Basle in Switzerland—not London, Brussels, or a Dutch city —should be the seat of the bank. Prior to the decision, four of the seven nations represented on the committee favored Brussels, but this was eliminated by the fixed opposition of the German delegates. Upon the choice of Basle, the Belgian delegates left the conference, but they subsequently signed the charter, statutes, and trust deed which had been prepared by the committee.

The provisions of these latter documents, which were completed and signed on November 13, in general left problems of a political nature unsolved, and at the same time considerably reduced the financial activities of the bank from the scope anticipated by the framers of the Young Plan. In particular, Article XX of the Bank Statutes, the so-called "veto clause," provides that before any financial operation "in a given country or a given currency," the central bank of that country shall have an opportunity to dissent, and this dissent will prevent the operation.

Control of the bank will rest in the hands of the six nations, Great Britain, France, Italy, Japan, Belgium, with provisional inclusion of the United States, holding 56 per cent of the $100,000,000 capital. This 56 per cent will be held by the central banks of the various countries, except that in the United States it will be held by the Morgan Company, and in Japan by a consortium of banks. It was expected that the chairmanship of the board of control would be given to a prominent American banker, perhaps Mr. M. A. Traylor of the American delegation, and that the general manager would be a Frenchman.

After completion of the committee's work it was revealed that the American delegates, finding the activities of the bank greatly limited by the conservatism of the European delegates, frequently intimated that no group of American bankers would care to cooperate. American participation was finally assured by a direct appeal to Mr. J. P. Morgan, then in London.

To complete the work of the bankers, a committee of jurists met in Brussels on December 1, and it was expected that a second Hague conference of political representatives would convene in January for final decisions regarding the bank and execution of the new plan of reparations.

GERMAN "LIBERTY LAW."—The so-called "Liberty Law," which if enacted would prevent German acceptance of the Young plan, was brought before the Reichstag in November by the method, provided in the German constitution, of securing a favorable vote from one-tenth of the German electorate. The one-tenth vote was barely secured, but the measure was overwhelmingly defeated in the Reichstag, with every prospect that it will be defeated in the popular referendum which must follow. Although there is at present a strong swing to the right in German politics, and much opposition to the new reparations arrangements, there is little prospect that this will reach the point of upsetting the Young plan. A favorable impression was created by the French evacuation of the second Rhineland zone which began November 30, and the assurance of complete evacuation as soon as the Young plan is actually working.

FRANCE

SUCCESS OF TARDIEU MINISTRY.—The majority of 79 votes in the French Chamber won by the Tardieu Ministry on November 9 following the presentation of the ministerial policies and program, was much larger than expected, and coupled with the strong speech of the premier, was taken as a promise of unforeseen stability and permanence for the new cabinet. Premier Tardieu gained support from the Right by promise of a firmer conduct of foreign and home affairs, Foreign Minister Briand placated the Left Center, and the opposition was confined to the more radical parties of the Left. Premier Tardieu indicated that French interests would be safeguarded, and Foreign Minister Briand not given an entirely free hand, in the London Naval Conference, the Conference on the Young Plan, and the next League Council meeting, all scheduled for the coming January.

SARRE NEGOTIATIONS.—Negotiations between France and Germany began at Paris on November 20 for settlement of the disposition of the Sarre basin before the date fixed by the Versailles Treaty. An agreement is sought by which German Sovereignty can be restored without injury to the French investments in the province amounting to $257,000,000, or three-fourths of its total wealth. French exploitation of the Sarre coal resources has raised the annual product to 14,000,000 tons, most of which is essential to the French steel industry. The Versailles Treaty provides for a plebiscite in the province in 1935, but it is recognized that the sentiment of the population is overwhelmingly in favor of return to German rule.

DEATH OF CLEMENCEAU.—Georges Clemenceau, physician, editor, expert swordsman, and wartime Premier of France, died in Paris of heart failure on November 24. He was in his eighty-eighth year. He had just completed a volume of memoirs vigorously defending his rule of France during the closing period of the war and his decision not to push the French boundaries up to the Rhine. A state funeral was contrary to Clemenceau's wishes, and he was buried simply in his native province of Vendée.

UNITED STATES AND LATIN AMERICA

RUBIO PRESIDENT OF MEXICO.—The Mexican presidential election on November 17 resulted in the choice of engineer Ortiz Rubio, candidate of the National Revolutionary Party, by an overwhelming vote. The figures of about 1,800,000 votes to 110,000 for the opposition candidate José Vasconcelos, no doubt mean little in view of wholesale methods of intimidation and violence used to suppress the opposition vote, but impartial observers were doubtful if Vasconcelos could have won in a fair election. Rubio was the choice of ex-President Calles, and his election means a continuation of the anti-Catholic, radical policies followed in Mexico under Obregon, Calles, and Portes Gil. President-elect Rubio left Mexico at the end of November for a trip to the United States which will include visits in New York and Washington.

ANTARCTIC TERRITORIAL CLAIMS.—The successful flight of the Byrd Expedition across the South Pole in November created a renewed interest in territorial claims in the antarctic continent. The United States Government on November 15 sent a somewhat belated reply to a British note of November, 1928, in which the British asserted possession of vast land areas in the antarctic, especially in the regions covered by the Byrd expedition. The American reply did not acquiesce in the British claims, but left the question open for future settlement. American claims are based largely on the discoveries of Commodore Wilkes in 1840, though antarctic territory has never been formally claimed by act of Congress. The question gains added importance from the possibilities of mineral resources in the region and its exploitation by aviation.

MISCELLANEOUS

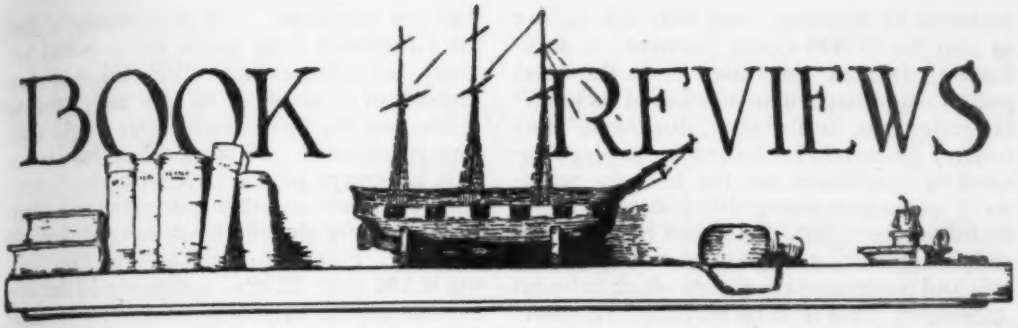
POPULATION AND WAR.—The *Living Age* of November 25 quotes a statement of Professor H. P. Fairchild of New York University that "A century of stationary population in all the countries of the world would do more to usher in an era of universal peace than all the disarmament agreements and anti-war treaties that have ever been penned."

This apparently simple solution of the war problem takes added interest from figures quoted elsewhere in the same magazine regarding the growth of population in Japan.

WHEN FORCE BACKED DIPLOMACY.—In a review, in *Time*, November 25, of the recently published and highly interesting correspondence of former British ambassador Spring-Rice, occurs the following extract from a letter of President Roosevelt regarding the Kaiser and the Monroe Doctrine:

"I have more than once been greatly exasperated with the Kaiser myself. When I first came into the Presidency I was inclined to think that the Germans had serious designs upon South America. But I think I succeeded in impressing upon the Kaiser, quietly and unofficially and with equal courtesy and emphasis, that any violation of the Monroe Doctrine by territorial aggrandizement on his part around the Caribbean meant war, not ultimately but immediately and without delay. He has always been as nice as possible to me since. . . ."

BOOK REVIEWS



BOOK DEPARTMENT

Members of the Institute may save money by ordering books through its Book Department, which will supply any obtainable book. A discount of 10 per cent is allowed on books published by the Institute, and 5 per cent on books of other publishers (government publications excepted). Address Secretary-Treasurer, U. S. Naval Institute, Annapolis, Maryland.

ECONOMIC FOREIGN POLICY OF THE UNITED STATES. By Benjamin H. Williams. New York: McGraw-Hill Book Company. 1929. $5.00.

REVIEWED BY BROCKHOLST LIVINGSTON

Economics are so closely bound up with foreign policy that Professor Williams' book fills a long-felt want. Perhaps it is even more valuable to the Navy because it has been on that service that the burden of enforcing our economic foreign policy has devolved, as testified so appropriately by the author. Much space is taken up with an exposition of this fact which is summed up in the following sentence:

> While large diplomatic movements and tendencies are ordinarily not reducible to measurement .... our economic influence can be traced roughly in the statistics of guns and tonnage that represent the growth of the American Navy.

The author has traced our varying policies and, in treating the questions from the differing viewpoints of our associates in the world of commerce, he has set before us a clear picture of our economic relations with the rest of nations. He does not make it clear whether he approves of our policies, although statements suggestive of criticism abound throughout the pages.

The inter-Allied debts, because of their importance to the future economic welfare of those concerned, receive extensive discussion. Of them he has this to say:

> If the whole question could be removed from the so-called "moral" plane and settled with a sincere desire to attain the best future interests of all countries, the matter would lose much of its complexity.

In a paragraph which he has called the "General Worthlessness of the 'Moral' Arguments," he brings out that

> The moral arguments as a class illustrate primitive reasoning on international subjects. There are no standards by which these claims can be measured, and there is a tendency to exaggerate them on both sides. To attempt to settle an important world controversy by that method can only result in sending each set of contenders into its shell of self-righteousness from which it cannot be driven.

To such statements he adds that "industry made Germany formidable and the lack of it made Russia impotent."

It would be possible to point out a lack of political foresight on the part of the author when he suggests that, in some future dispute with European nations, a declaration of war by them may be conceived as an easy method of cancellation of their indebtedness to the United States. It is also difficult to reconcile such an idea with his advocacy of greater participation in the submission of disputes to friendly adjustment.

It does not require great persuasion to agree with the writer that "economic forces are .... more important factors in the success or failure of government monopolies than are the attitudes of state departments and foreign offices." The past policy of the United States to shun the participation of the government in industry is proof of a proper appreciation of this fact.

In his concluding chapter, which he has entitled "The Economic Diplomacy of the Future," Professor Williams believes that, at present, "the United States has fallen behind in the movement for the friendly ad-

justment of disputes," and that our failure to join the World Court "amounts to a refusal to become associated with the most practical and hopeful institution of its kind." He states that, in his belief, this marks "this country as clearly backward in the development of machinery for the friendly settlement of international difficulties." In so branding the nation, the author has conveniently forgotten many incidents of past history and contemporary events which belie his statements. This is to be regretted as, otherwise, the book is a valuable one for the student of domestic and foreign affairs, and these opinions should not overshadow the usefulness of the volume in depicting accurate facts on the questions discussed.

LUNAR EPHEMERIS FOR AVIATORS. Aëronautical Supplement to the American Ephemeris and Nautical Almanac, 1929. Washington, D.C., Government Printing Office.

REVIEWED BY LIEUTENANT COMMANDER P. V. H. WEEMS, *U. S. Navy*

The Aëronautical Supplement to the *American Nautical Almanac*, 1929, was distributed to ships and air stations of the Navy in September, 1929. While it is designated "Lunar Ephemeris for Aviators," it is applicable, of course, to marine navigation. In fact, it will find its greatest present use at sea. Only the last four months of 1929 are included in this, the first volume, and its future depends on the reception the tables receive in the service. It is a neatly printed volume 7x10x¼ inches, paper bound and similar to the Nautical Almanac except that its color is a light gray-green.

While the tables are exceptionally clear and easy to use, it is believed that its appearance and utility can be enhanced in minor ways. For instance, by close economy of space the size may be reduced to approximately that of the Nautical Almanac. The name might be changed to "Lunar Ephemeris for Aviators and Mariners" so that seafaring persons will not ignore it. While designed primarily for aviators, who will use bubble sextants, it does not contain altitude corrections for the bubble sextant.

The tables are made out for every ten minutes of Greenwich civil time. Instead of the usual right ascension and declination, the Greenwich hour angle and the declination are tabulated. All this means is that the Greenwich hour angle is computed for every ten minutes and tabulated that way instead of leaving it to the navigator to figure out the Greenwich hour angle each time it is needed. To show what this means, it is necessary to start off with the Greenwich civil time and then compute the Greenwich hour angle of the moon by the old method. First we must add to the GCT the RAM ⊙ + 12 hrs., and then add the correction for the longitude (Table III). This operation will give the Greenwich sidereal time. The right ascension is found by a tedious interpolation and applied to the GST to get the Greenwich hour angle. Since right ascension is tabulated in time units, this must be converted to arc. When this is done, we get the same value that is tabulated for every ten minutes in the Lunar Ephemeris. Also, since the declination is given for every ten minutes, very little interpolation is required for this.

It is much better to make the observation on the even ten minutes to avoid all interpolation. If the observation is made at an odd time, there is a rather large interpolation for the Greenwich hour angle. This comes about because of the fact that the hour angle of the body, neglecting its change in right ascension, changes approximately fifteen minutes of arc for every minute of time, which is much faster than the right ascension changes. On the other hand, the minute difference is given to facilitate the interpolation when this is necessary. The minute difference is given to two decimal places. Since the interpolation is never for more

MOON, 1929

G. C. T.	Right Ascension				Declination			S. D.	H. P.
	October 16.								
h	h	m	s		°	′		′	′
0	23	34	29	233	− 7	12.0	291	15.4	56.5
2	23	38	22	232	6	42.9	292	15.4	56.5
4	23	42	14	233	6	13.7	294	15.4	56.6
6	23	46	7	233	5	44.3	296	15.5	56.6
8	23	50	0	233	5	14.7	297	15.5	56.7
10	23	53	53	233	4	45.0	299	15.5	56.7
12	23	57	46	234	4	15.1	300	15.5	56.8
14	0	1	40	233	3	45.1	301	15.5	56.9
16	0	5	33	234	3	15.0	303	15.5	56.9
18	0	9	27	234	2	44.7	304	15.5	57.0
20	0	13	21	235	2	14.3	305	15.6	57.0
22	0	17	16	235	1	43.8	306	15.6	57.1

TABLE I
From Nautical Almanac

MOON, 1929

Greenwich Civil Time

G. C. T.	Greenwich Hour Angle	Var. per Min.	Declination	G. C. T.	Greenwich Hour Angle	Var. per Min.	Declination	G. C. T.	Greenwich Hour Angle	Var. per Min.	Declination
	OCTOBER 16				OCTOBER 16				OCTOBER 16		
h m	° ′	′	° ′	h m	° ′	′	° ′	h m	° ′	′	° ′
0 0	30 24.2	14.56	−7 12.0	8 0	146 51.1	14.56	−5 14.7	16 0	263 17.5	14.55	−3 15.0
10	32 49.7	14.56	7 9.6	10	149 16.7	14.56	5 12.2	10	265 43.0	14.55	3 12.4
20	35 15.3	14.56	7 7.2	20	151 42.2	14.56	5 9.8	20	268 8.6	14.55	3 9.9
30	37 40.9	14.56	7 4.8	30	154 7.8	14.56	5 7.3	30	270 34.1	14.55	3 7.4
40	40 6.4	14.56	7 2.3	40	156 33.3	14.56	5 4.8	40	272 59.7	14.55	3 4.9
50	42 32.0	14.56	6 59.9	50	158 58.9	14.56	5 2.4	50	275 25.2	14.55	3 2.4
1 0	44 57.5	14.56	−6 57.5	9 0	161 24.5	14.56	−4 59.9	17 0	277 50.7	14.55	−2 59.8
10	47 23.1	14.56	6 55.1	10	163 50.0	14.56	4 57.4	10	280 16.3	14.55	2 57.3
20	49 48.7	14.56	6 52.7	20	166 15.6	14.56	4 54.9	20	282 41.8	14.55	2 54.8
30	52 14.2	14.56	6 50.2	30	168 41.1	14.56	4 52.4	30	285 7.4	14.55	2 52.3
40	54 39.8	14.56	6 47.8	40	171 6.7	14.56	4 50.0	40	287 32.9	14.55	2 49.8
50	57 5.4	14.56	6 45.5	50	173 32.2	14.56	4 47.5	50	289 58.4	14.55	247.2
2 0	59 30.9	14.56	−6 42.9	10 0	175 57.8	14.56	−4 45.0	18 0	292 24.0	14.55	−2 44.7
10	61 56.5	14.56	6 40.5	10	178 23.3	14.56	4 42.5	10	294 49.5	14.55	2 42.2
20	64 22.1	14.56	6 38.1	20	180 47.9	14.56	4 40.0	20	297 15.0	14.55	2 39.6
30	66 47.6	14.56	6 35.6	30	183 14.4	14.56	4 37.5	30	299 40.6	14.55	2 37.1
40	69 13.2	14.56	6 33.2	40	185 40.0	14.56	4 35 0	40	302 6.1	14.55	2 34.6
50	71 38.7	14.56	6 30.8	50	188 5.5	14.56	4 32.6	50	304 31.6	14.55	2 32.0
3 0	74 4.3	14.56	−6 28.3	11 0	190 31.1	14.56	−4 30.1	19 0	306 57.2	14.55	−2 29.5
10	76 29.9	14.56	6 25.9	10	192 56.7	14.56	4 27.6	10	309 22.7	14.55	2 27.0
20	78 55.4	14.56	6 23.5	20	195 22.2	14.56	4 25.1	20	311 48.2	14.55	2 24.4
30	81 21.0	14.56	6 21.0	30	197 47.8	14.56	4 22.6	30	314 13.7	14.55	2 21.9
40	83 46.6	14.56	6 18.6	40	200 13.3	14.56	4 20.1	40	316 39.3	14.55	2 19.4
50	86 12.1	14.56	6 16.1	50	202 38.9	14.56	4 17.6	50	319 4.8	14.55	2 16.8
4 0	88 37.7	14.56	−6 13.7	12 0	205 4.4	14.56	−4 15.1	20 0	321 30.3	14.55	−2 14.3
10	91 3.2	14.56	6 11.3	10	207 30.0	14.56	4 12.6	10	323 55.9	14.55	2 11.8
20	93 28.8	14.56	6 8.8	20	209 55.5	14.56	4 10.1	20	326 21.4	14.55	2 9.2
30	54.4	14.56	6 6.4	30	212 21.1	14.56	4 7.6	30	328 46.9	14.55	2 6.7
40	98 19.9	14.56	6 3.9	40	214 46.6	14.56	4 5.1	40	331 12.4	14.55	2 4.2
50	100 45.5	14.56	6 1.5	50	217 12.2	14.56	4 2.6	50	333 38.0	14.55	2 1.6
5 0	103 11.0	14.56	−5 59.0	13 0	219 37.7	14.56	−4 0.1	21 0	336 3.5	14.55	−1 59.1
10	105 36.6	14.56	5 56.6	10	222 3.3	14.55	3 57.6	10	338 29.0	14.55	1 56.5
20	108 2.2	14.56	5 54.1	20	224 28.8	14.55	3 55.1	20	340 54.5	14.55	1 54.0
30	110 27.7	14.56	5 51.7	30	226 54.3	14.55	3 52.6	30	343 20.1	14.55	1 51.5
40	112 53.3	14.56	5 49.2	40	229 19.9	14.55	3 50.1	40	345 45.6	14.55	1 48.9
50	115 18.8	14.56	5 46.8	50	231 45.4	14.55	3 47.6	50	348 11.1	14.55	1 46.4
6 0	117 44.4	14.56	−5 44.3	14 0	234 11.0	14.55	3 45.1	22 0	350 36.6	14.55	−1 43.8
10	120 10.0	14.56	5 41.8	10	236 36.5	14.55	3 42.6	10	353 2.1	14.55	1 41.3
20	122 35.5	14.56	5 39.4	20	239 2.1	14.55	3 40.1	20	355 27.7	14.55	1 38.8
30	125 1.1	14.56	5 36.9	30	241 27.6	14.55	3 37.6	30	357 53.2	14.55	1 36.2
40	127 26.6	14.56	5 34.4	40	243 53.2	14.55	3 35.1	40	0 18.7	14.55	1 33.6
50	129 52.2	14.56	5 32.0	50	246 18.7	14.55	3 32.6	50	2 44.2	14.55	1 31.1
7 0	132 17.8	14.56	−5 29.5	15 0	248 44.3	14.55	−3 30.0	23 0	5 9.7	14.55	−1 28.6
10	134 43.3	14.56	5 27.1	10	251 9.8	14.55	3 27.5	10	7 35.2	14.55	1 26.0
20	137 8.9	14.56	5 24.6	20	253 35.3	14.55	3 25.0	20	10 0.8	14.55	1 23.4
30	139 34.4	14.56	5 22.1	30	256 0.9	14.55	3 22.5	30	12 26.3	14.55	1 20.9
40	142 0.0	14.56	5 19.7	40	258 26.4	14.55	3 20 0	40	24 51.8	14.55	1 18.4
50	144 25.6	14.56	5 17.2	50	260 52.0	14.55	3 17.5	50	17 17.3	14.55	1 15.8
8 0	146 51.1	14.56	−5 14.7	16 0	263 17.5	14.55	−3 15.0	24 0	19 42.8	14.55	−1 13.2
h m				h m				h m			
0 0	Semid., 15′.4 Hor. Par., 56′.5			8 0	Semid., 15′.5 Hor. Par., 56′.7			16 0	Semid., 15′.5 Hor. Par., 56′.9		

NOTE.—0h Greenwich Civil Time is twelve hours before Greenwich Mean Noon of the same date

TABLE II

From Lunar Ephemeris

than ten minutes, the minute difference might well be given to the nearest tenth, thus saving one column of figures.

The Greenwich hour angle is tabulated from 0 to 360 degrees. It might be more convenient to have the tabulation from 0 to 180 degrees to the east and to the west.

The semidiameter and horizontal parallax are given for every eight hours only. Sample problems are given to illustrate the use of the tables.

To illustrate the difference between the old and the new tables, a sample of each will be given for one day, October 16, 1929. To show the actual work saved, one example will be given.

Required, the Greenwich hour angle and declination of the moon for GCT 10h-10m-00s on October 16, 1929.

SOLUTION

Old Method

		h m s	
GCT		10-10-00	
RAM ⊙ + 12		1-36-05.7	
Table III		1-40.2	
GST		11-47-45.9	
RA		23-54-12.9	
GHA (time)		11-53-33.0	
GHA (arc)		17- 8-23.4§	
	RA		*Dec.*
For 10 hrs.	23-53-53		4-45.0 S
Corr. 10 m.	19.4		(-)2.5
RA	23-54-12.4		4-42.5 S§

Correction: 233 x 10/120=19″.4 (+)
Correction: 29.9 x 10/120=2′.5 (—)

New Method

GCT 10-10-00 GHA 178-23.3§
Dec. 4-42.5 S§

In actual practice, it is the work saved by the new moon tables which has heretofore caused many navigators to shun the use of the moon altogether for navigation. Now that the moon sight becomes easier, when observed on the ten-minute intervals, than the sun sight, there will exist no longer the prejudice against the moon as a navigational body.

The advent of the Lunar Ephemeris will increase the value of the second-setting navigation watches, since these timepieces show the exact second of time and thereby provide at a glance the time to observe the moon in order to avoid all interpolation. These watches are being supplied to the ships and air stations by the Naval Observatory in the order the requests are received from ships and stations. It will be noted that the same watch is used for a moon sight as is used for a sun sight.

To sum up the advantages of the new Lunar Ephemeris we have:

(1) No interpolation on even ten minutes, and an easy interpolation for all conditions.
(2) No GST required.
(3) No RA required.
(4) A saving of about 70 per cent in the solution of the moon sight over the old method.
(4) Practically no chance of making an error in finding the GHA and the Dec.

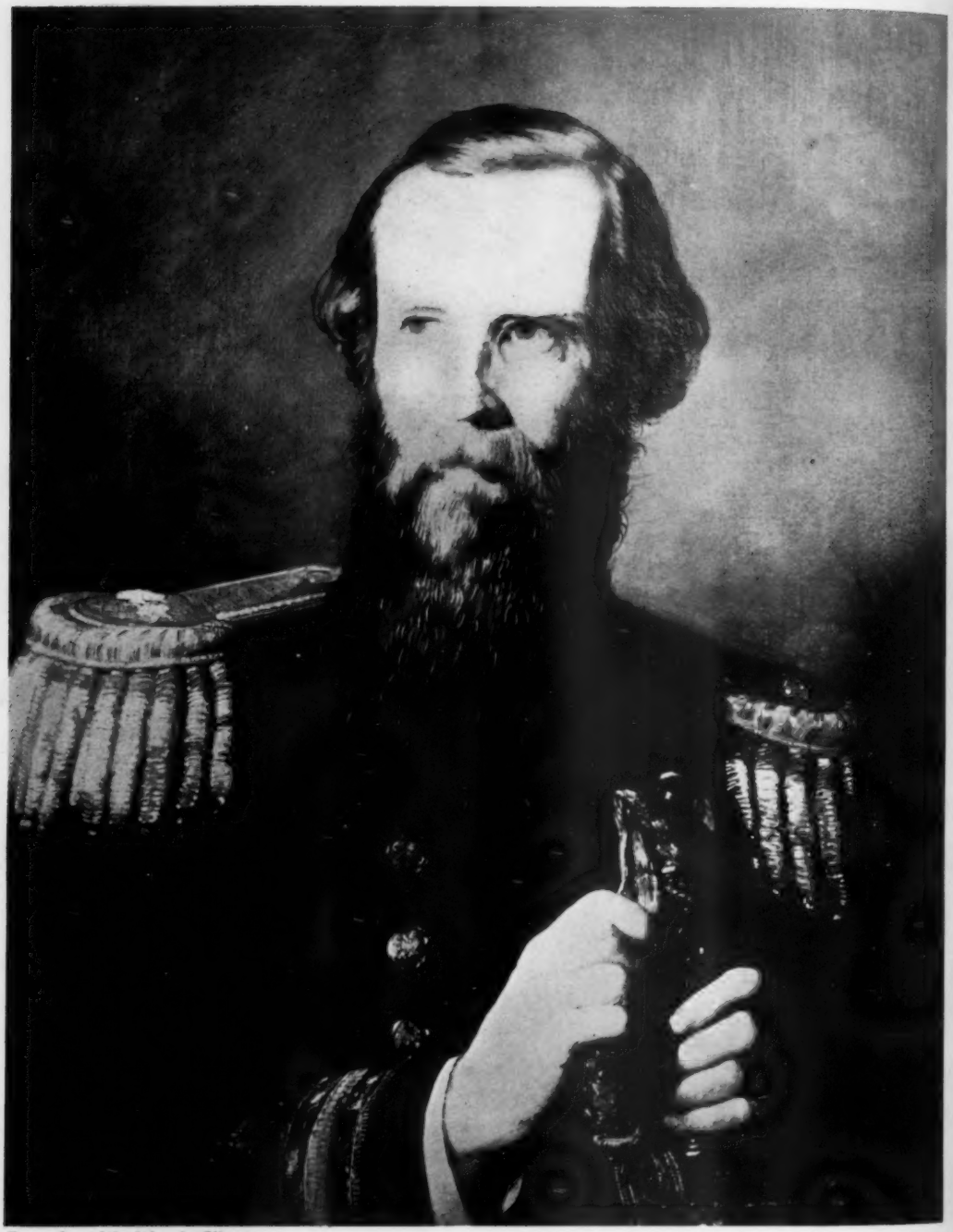
The Lunar Ephemeris is a credit to the Naval Observatory and this step in the simplification of nautical tables will, it is hoped, prove a forerunner to other and greater savings for the navigator. With high-speed ships and with aircraft the saving in time alone, by using the new tables, is an important item. Next we might arrange special tables for Venus, and give the sun's elements for every hour instead of every two hours as at present.

Courtesy Naval War College. *From the Macpherson Collection (From a color lithograph by Sherman & Hart, published 1862)*

ENCOUNTER BETWEEN THE *MONITOR* AND *MERRIMAC* IN HAMPTON ROADS, MARCH 9, 1862

The *Monitor* was commissioned February 25, 1862, by Lieutenant John L. Worden, her first commanding officer. She put to sea March 6, and engaged the *Merrimac* on March 9. Lieutenant Worden was wounded during the action, having been stunned and blinded by a shell which exploded against the pilot house.

UNIV. OF WASH.

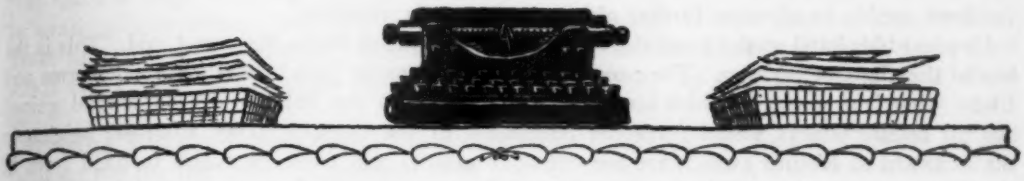


From the original by A. Gliemann

REAR ADMIRAL JOHN L. WORDEN, U. S. NAVY
The second President of the U. S. Naval Institute, 1874

The original of this photograph was bequeathed to the Naval Academy by William M. Woodworth, a friend of Admiral Worden.

SECRETARY'S NOTES



The London Conference

This month will see the convening of the five leading naval powers in an effort to reduce as well as to limit the naval establishments of the powers represented. The year 1930 is apt to be fateful in its results.

The members of the conference will find themselves in anything but a child's game; the stakes are high, theories are to challenge the facts of history, nations are to adjust their national defense to other than their political necessities or aspirations.

Present indications are that, although Great Britain and the United States are practically agreed on certain major principles, Japan, France, and Italy have definite ideas of their own that will have to be considered. The United States will not be in the powerful position she occupied in 1922, as she has not so much to give away.

The personnel of the delegation is all that could be desired; certainly no more able a delegation has represented this country abroad and the country can rest assured that its interests will be looked out for.

The advisory group of naval officers is comprised of outstanding officers who are entirely conversant with the needs of the country and who know the relative merits of the various types of naval armament.

The League of Nations, land armament, the needs for an increase in the cases of individual nations, submarines, and aircraft—all of these will have to be considered, and the problem is a tremendous one.

The stage is set, the cast has been selected, the show is bound to be intensely dramatic. Let us hope there will be a happy ending!

The Battle at Blanc Mont

We asked General Lejeune to kindly comment on Colonel Otto's article "The Battle at Blanc Mont," which begins in this issue. As General Lejeune commanded the American 2d Division, which was the spearhead of this operation, he speaks with authority. His letter is quoted below:

I have read Lieutenant Colonel Otto's description of the "Battle at Blanc Mont" several times with the most intense interest.

The narrative, giving as it does the reports of such a large number of German units, many of them companies, is necessarily very complicated and difficult to follow, and to analyze it fully would require an article of approximately equal length. Perhaps, therefore, it would be of greater interest for me to state briefly, and in general terms, the mission assigned to the 2d Division and the manner of its execution rather than to attempt to go into a large number of details. In an interview with General Gouraud, the commander of the French 4th Army, on September 28, he described the progress of the great battle then raging between the Meuse and Suippe Rivers which had been initiated on September 26 by the American and the French 4th Armies.

During the interview we faced a relief map of the Champagne country extending from the western border of the Argonne Forest to the Suippe River. General Gouraud pointed out on the map the progress made by his army during the first two days of the attack and stated that it was then held up by the powerful defensive position occupied by the German Army and had so far been unable to advance further although repeatedly attacking.

He placed his hand on the great ridge which we have called Blanc Mont and said, "This is the key of the German position. The penetrating of the German lines between Médéah Ferme and Blanc Mont [the sector on which his hand was placed] and the holding of the ground gained against counterattacks would force the retirement of the German Army from the heights to the eastward of Rheims (which are too strong to attack) and from the entire fortified front in the Champagne to the north bank of the Aisne River, a distance of about thirty kilometers." I replied that I felt confident that the 2d Division could take the ridge by assault if strongly supported by artillery fire.

The 2d Division was ordered to the front on September 29-30, to make the attack. It entered the front lines to the westward of Sommepy on the night of October 1-2, and attacked at dawn October 3 after five or ten minutes artillery preparation. The plan of attack emanated from the 2d Division. The attack was completely successful, as was the exploitation of the immediate front by the 3d Brigade on the afternoon of that day, for the purpose of establishing an outpost position in front of the main position.

On the night of October 3, the retreat of the enemy forces from the heights east of Rheims was effected and on the following days the 2d Division sustained and repulsed terrific counterattacks against both of its flanks from all available German reserves on that front, which were made with the avowed purpose of destroying the division and reëstablishing the German lines on the ridge. The 2d Division occupied a wedge-shaped salient; its flanks were unsupported by the adjacent divisions; its regiments fought and defeated, after a terrific struggle, the bravest and the best of the German regiments; the division not only held its position but advanced its lines; and the entire German Army retired to the north bank of the Aisne River.

In my judgment no single division of the American or any other army accomplished any more in five days than did the 2d Division in the Battle of Blanc Mont. I say this with all due respect for the German troops. They are entitled to high commendation for the efficiency, the dogged determination, and the high courage which they displayed on that bloody field. They were worthy foes and to have defeated such foes adds all the more to the renown of the 2d Division.

In conclusion I feel impelled to add that too much praise or too much glory cannot be given to the heroic souls of the 2d Division who bore the brunt of that bitter struggle and who enforced their wills on the opposing forces.

With renewed thanks to the United States Naval Institute for having obtained the article and for having sent it to me, I remain,

Most sincerely yours,
JOHN A. LEJEUNE
Major General, U. S. Marine Corps
Former Commander, 2d Division, A.E.F.

Ether drift in evidence

An article appeared in the Baltimore *Sun*, of December 8, which bears on two articles appearing in this issue of the PROCEEDINGS, namely, "The Researches of Professor A. A. Michelson," and "The Velocity of Light." We are quoting the article below in the hope it will throw more light on the velocity of light.

Ten scientific evidences agree to show the earth, the sun, and the rest of the solar system drifting through space toward a part of the sky marked by the constellations Hercules and

the Dragon, close to the northern horizon at midnight at this time of the year. So reported Professor Dayton C. Miller, of the Case School of Applied Science, in describing to the recent meeting of the National Academy of Sciences at Princeton, New Jersey, his experiments on "ether drift."

If space is filled with this so-called ether supposed to carry light, the earth's motion ought to be measurable by delicate enough tests much as one measures a ship's motion through water. Years ago, two other Cleveland scientists carried out the famous Michelson-Morley experiment which failed to detect this ether drift and came to be one of the facts leading to the Einstein theories.

Professor Miller has spent years repeating these tests and agrees that the motion of the earth around the sun causes no detected ether drift. Perhaps the ether, too, revolves around the sun, as though a ship were inside a whirlpool.

But he does find evidence of another ether drift, like one which would be caused by a motion of the whole solar system.

This was found, he reports, in the original Michelson-Morley experiment, but was believed to be a small accidental error. Professor Miller's new measurements show the sun's family moving toward the constellation Draco. The other nine evidences: from the tides, from the cosmic rays, and from several kinds of star observations, indicate directions not far from this.

Although the possibility of measuring ether drift is denied by present forms of the Einstein theories, the agreement of his measurements with the other nine evidences implies, Professor Miller believes, that there is something in the idea, Einstein or no Einstein.

Yes, we have no discussions

It will be noted that this issue of the PROCEEDINGS carries no "Discussions." We would like to feel that our material is so good that there is no room for discussion but we fear that such is not the case. We have no discussions to publish and we feel their absence. Do not let this interesting feature of the PROCEEDINGS die from disuse.

Not bad

This year the Navy entered the competition for the Rhodes scholarships for the first time. The Navy took six of the thirty-two scholarships to be awarded in this country. We understand this to be an all-time record, being more than any college or university has ever qualified in one year.

We hoped to see some editorial comment on the Navy's success, but it was strangely absent. But suppose the Navy had qualified six men on the all-American football team!

Which reminds us, some four years ago the death of Rudolph Valentino was the occasion of special editions of afternoon papers. We found, tucked away in a corner of the same edition, the news of the death of Dr. Charles W. Eliot, President Emeritus of Harvard University.

It's a question of news value!

Delay in mailing the December "Proceedings"

Through circumstances beyond our control, the mailing of the December issue was delayed one week. If any member failed to receive that copy, we will gladly mail a duplicate upon request.

"Naval Leadership"

This big little book has again been revised and printed in its 1929 edition. This is the third printing for *Naval Leadership*, which shows its popularity.

The book, printed in a size suitable for the pocket, is crammed full of

facts and experiences of naval and military leaders. The problems of leadership are common to all professions that require the direction and control of men. As one reads this book, he is amazed at the things that have confronted others which he believed only he, himself, had experienced.

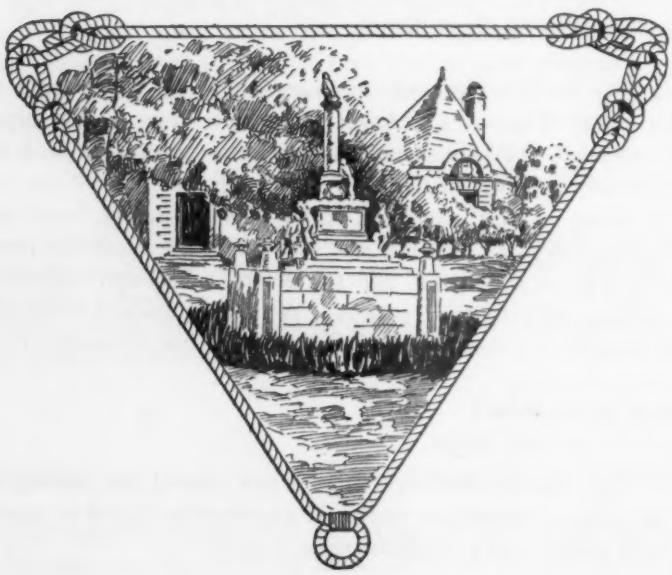
Every officer should have a copy of *Naval Leadership;* it will prepare him to meet situations.

Price: $1.50, postpaid (10 per cent off to members of the Institute).

A five-book shelf

We all have read or know of Dr. Eliot's "Five-Foot Shelf of Books." The Naval Institute has a Five-Book Shelf, equally valuable.

These five books cover the subject of marine engineering as it applies to the Navy, and we list them below:

Naval Reciprocating Engines.....price $	2.50
Naval Turbines.....	5.00
Internal-Combustion Engines.....	3.40
Naval Auxiliary Machinery.....	3.50
Marine and Naval Boilers.....	3.00

(All prices, postage prepaid, 10 per cent off to members of the Naval Institute.)